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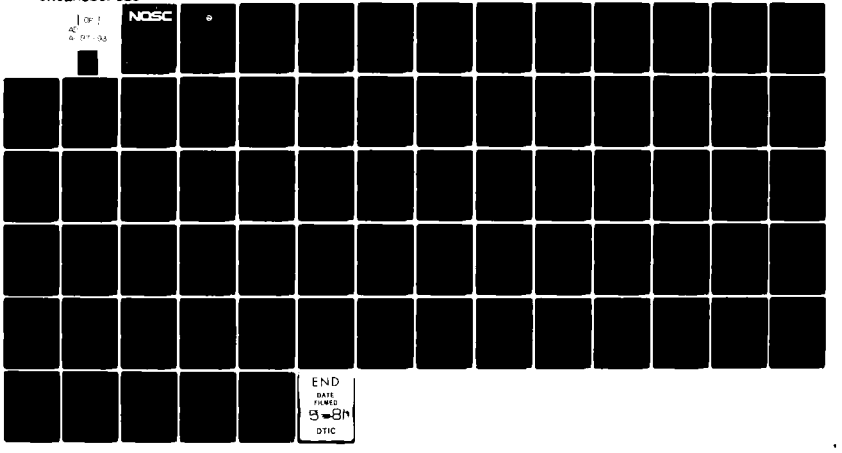

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FUTURE DEFENSE COMMUNICATIONS AGENCY NETWORK REQUIREMENTS IN SUPPORT OF DEPARTMENT OF DEFENSE OFFICE AUTOMATION

T.L. Comport

1 February 1981

Prepared for
DEFENSE COMMUNICATIONS AGENCY
Defense Communications Engineering Center
Reston, VA 22090

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DoD lags the civilian business sector by 5 to 10 years in planning and incorporating new office technologies. Very little coordinated effort to remedy this situation is evident. There is a lack of compatible interfaces among office automation technologies. There is a lack of knowledge on the part of potential users of automation technologies regarding availability and capabilities of these technologies. No quantitative circuit loading projections are available at any level of the MILDEPS or Agencies. There is no DoD-wide planning for office automation. The lack of quantitative requirements and knowledge regarding use of office automation technologies does not permit one to define or determine the impact of office automation technologies on future communication needs. Technical sophistication of office automation equipments has

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progressed to a point where capabilities represented are highly attractive to the user and certain cost savings are becoming obvious. Users as a group are attracted to the new capabilities offered and are universally "thinking" in this direction. In some cases, planning has occurred and in some areas system/network installations have been accomplished or are in the planning stage. Many of the users and potential users of these systems and networks are uninformed as to the communications impact and are being guided by the individual equipment manufacturers and network vendors. One possible recommendation to provide a solution to the identified problems is that a working group be formed by DoD to pursue the subject of office automation and resulting communications requirements. Development of similar working groups in each of the DoD MILDEPS and Agencies is indicated as the prime point of interface between the OSD working group and the MILDEPS and Agencies.

EXECUTIVE SUMMARY

Three successive and related studies attempted to identify the extent to which the automation of offices in DoD might affect 1980 - 1995 traffic load planning for DCS network capacity.

The DoD lags the civilian business sector by five to ten years in planning and incorporating the new office technologies. In fact, very little coordinated effort is apparent within DoD at a high enough level at the present time to forsee accurately what will be the extent of office automation in the future other than to say that modernizing trends will be significant.

The present studies proved to be inconclusive in terms of defining quantitative automation traffic load requirements for the various MILDEPS and Agencies within the DoD which would directly affect telecommunicatons network planning. The qualitative results, however, are significant in that they raise the fundamental issue of whether the right questions were being asked at the right command level.

As a result of synthesizing the findings of the series of three studies, the following problem areas are identified:

+ There is a lack of compatible interfaces among office automation technologies
+ There is a lack of knowledge on the part of potential users of automation technologies regarding availability and capabilities of those technologies
+ No quantitative circuit loading projections are available at any level of the MILDEPS or Agencies
+ There is no DoD wide planning for office automation

and the following key conclusions are stated:

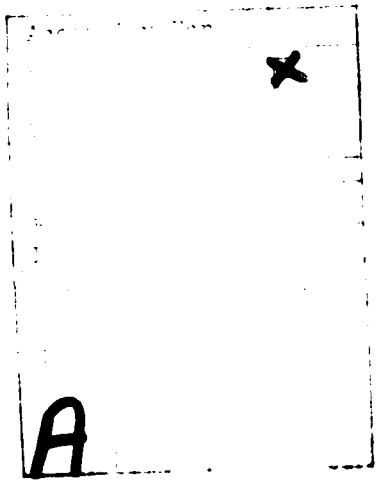
+ The lack of quantitative requirements and knowledge regarding use of office automation technologies does not permit one to define or determine the impact of office automation technologies on future communication needs
+ Technical sophistication of office automation equipments has progressed to a point where capabilities represented are highly attractive to the user and certain cost savings are becoming obvious

+ Users as a group are attracted to the new capabilities offered and are universally "thinking" in this direction. In some cases planning has occurred and in some areas system/network installations have been accomplished or are in the planning stage. Many of the users and potential users of these systems and networks are uninformed as to the communications impact and are being guided by the individual equipment manufacturers and network vendors.

The following recommendations are presented for consideration:

+ One possible recommendation to provide a solution to the identified problems is that a working group be formed by the DoD to pursue the subject of office automation and resulting communications requirements. In order for the working group to receive the necessary recogniation and support it should be placed at the level of the Office of the Secretary of Defense (OSD). Membership of the working group should be drawn from all interested DoD agencies with the chairman being selected from a position external to those bodies and reporting to the Secretary of Defense.
+ Development of similar working groups in each of the DoD MILDEPS and Agencies is indicated as the prime point of interface between the OSD working group and the MILDEPS and Agencies.

Increased emphasis on office automation is inevitable throughout the DoD. A high level effort to identify the applications and associated technologies with specific requirements by the MILDEPS and Agencies is required, not only to permit quantification of communications requirements, but to assure future compatibility and interoperability of involved hardware and software.



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1.0 INTRODUCTION

1.1 Report Objective. The objective of this report is to assess in qualitative terms the impact of office information handling automation trends within the Military Departments (MILDEPS) and other Agencies on Department of Defense (DoD) telecommunications networks based on information available to date. This information is required by the Defense Communication Agency (DCA) so that future DoD telecommunications network planning may continue out into the 1990 - 1995 time era.

To clarify this objective and its scope, several definitions are necessary.

1.1.1 Definition: Office information handling automation. Refers to modern computer and communications technology which is being developed to permit quick, accurate, and non-labor intensive electronic information transfer between offices using such media as electronic mail, teleconferencing, electronic word processing, facsimile, micrographics, i.e., the rapid exchange of multi-media information over communication channels to geographically separated locations.

1.1.2 Definition: Available information. Information available to this report comes from two previous studies which analyzed the trends in the technological development of automated office information transfer systems of the future and projected future non-tactical, office automation related, communications usage within the DoD services.

1.1.3 Definition: Specific assessment objectives. To accomplish the objective of this report, two questions must be answered: (1) To what extent is the technology, already beginning to be utilized in the civilian sector and which allows rapid information exchanges between administratively connected offices, likely to be adopted by the DoD to accomplish its business in the 1990 - 1995 time frame? (2) Will the adoption of the new automation technologies impose any special design problems for DLA in its 1990 - 1995

telecommunications network design in terms of unanticipated communication modes or traffic demands which must be added due to these new technological trends.

1.2 Approach. Several tasks were performed to accomplish the objectives of this report: (1) the data collected from the two previous studies [1] [2] were categorized and synthesized so as to relate probable future information handling technologies which are known to be developing in the civilian sector to DoD requirements for such capabilities (or reflected in current Tri-Service communication planning) for the 1990 - 1995 time frame; and (2) the results of the above task effort were translated into qualitative projections as to the nature of the traffic loads to be imposed on DCA networks in 1990 - 1995, as well as likely traffic volumes to be generated by DoD which may have to be added to planned capacity due to the incorporation of new office automated technologies.

1.3 Background. The present report represents a synthesis of the results of two previous studies undertaken by Naval Ocean Systems Center (NOSC) under the sponsorship of the DCA.

The intent of this series of studies was to provide the Defense Communication Engineering Center (DCEC), the systems engineering branch within DCA, with information about the probable growth of office automation technology in the DoD military services and other DoD agencies which might lead to future requirements wherein DCEC would have responsibility to plan for growth in telecommunication networks during 1990 and beyond.

The first study [1], hereafter referred to as the Task 1 study, undertook a technological survey of the state of the art in office automation methods which might lead to inter-exchange of information between offices over telecommunication networks. The second study [2], hereafter referred to as the Task 2 study, investigated the extent to which the three Services are actually planning to incorporate these new technologies into their administrative operations.

It is from these data that a synthesis may be performed of the status of DoD planning for intercommunicating automated offices in relation to the new developing technologies and placed in a format useful to DCA/DCEC in its future telecommunication network design. This synthesis effort, the subject of the present report, is hereafter referred to as Task 3.

2.0 RESULTS SUMMARY OF TASK 1 AND TASK 2 STUDIES

2.1 General Information. The results of Task 1 and Task 2 studies are presented in this section in summary form. The purpose of a brief review of this material is to furnish the reader with sufficient information so that the present report will stand by itself without extensive knowledge of the actual Task 1 and Task 2 documents.

This purpose is accomplished in two ways. First, condensed versions of the Task 1 study and the Task 2 study are presented in Appendix A and Appendix B. These Appendices offer the basic substance of each report for quick reference. Second, what amounts to an Executive Summary of each of the studies is extracted and brought up into the body of the present report along with several key Figures so that significant findings may be briefly presented and discussed.

2.2 Summary of Task 1 Results.

2.2.1 Context of Task 1 study. Task 1 had as its purpose the study and analysis of current literature which forecasts the application of state-of-the-art computer and communications based technology to the information handling aspects of office administration. In particular, the study concentrated on the problem of efficient and rapid information exchanges between geographically separated offices and individuals and in techniques which may be capable of handling the apparent exponential growth in information exchange requirements. The study focused on the civil sector, which has been much more rapid in its incorporation of the new office technologies than has the DoD, perhaps because of different mission-oriented and cost-effectiveness natures.

A basic assumption of the study was that most, if not all, of the civil sector state-of-the-art office technologies identified in Task 1 will be incorporated into DoD administrative operations after a time lag of five to ten years.

A picture is presented in the Task 1 report of what is at the forefront of civilian office automation technology in terms of function, communications modes to support the function, and some indication of the channel capacity or anticipated communications capabilities to accommodate these functions.

2.2.2 Significant findings of Task 1 study. The Task 1 study addresses an analysis of trends in the development of information transfer systems of the future, such as electronic mail transfer, teleconferencing, communicating word processors, facsimile, micrographics, and other technological advances which allow the rapid exchange of multi-media information over communication networks to geographically separated locations. The importance of these technologies to DoD resides, among other things, in the continuing energy crisis and the necessity to reduce travel, cut information transfer costs associated with traditional delivery methods, and to reduce transfer delays of important and perishable information.

The results of the present analysis indicate a significant proliferation over the next decade in the application and usage of these developing technologies. The communications medium appears to be the 9600 bit line capability offered by the common-carrier telecommunications networks for most information exchanges in real time but there also may be special requirements for high bandwidth networks to handle video, micrographics, and rapid batch data transfer of material.

The Task 1 study defines the information handling and information processing technologies which are becoming wide-spread in their adoption within the civil sector. Figures 1, 2 and 3 (shown as Figures A3, A4, and A5 in Appendix A) translate these definitions into functional terms of interest to the DoD telecommunications world.

Figure 1 (Correlation of Technologies and Functions) identifies the top twelve information exchange technologies which are now being automated in the business world and relates these to nine information exchange functions. Thus, there are at least 108 possible applications which may require telecommunications links, if adopted by the DoD.

Figure 2 (Digital Interconnections Between Office Equipments and a Controller) indicates how some 108 technology/function combinations might be reduced to seven generically different types of telecommunications transmission media, possibly requiring different bandwidths or channels.

Figure 3 (Dispersed or Distributed Office Functions Connected by Digital Communications Circuits) shows how work centers within DoD might have to be interconnected with data bases, a central processing capability, and with each other.

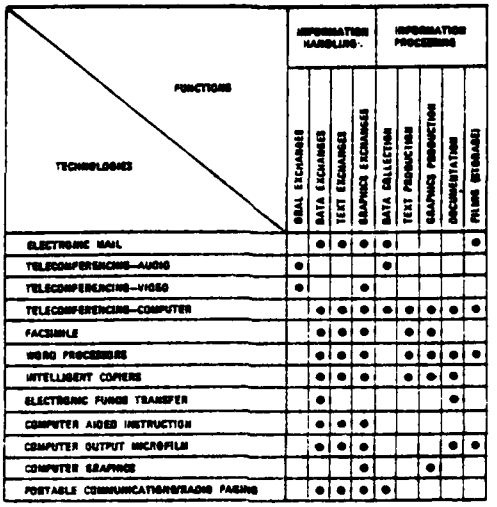


Figure 1. Correlation of Technologies and Functions

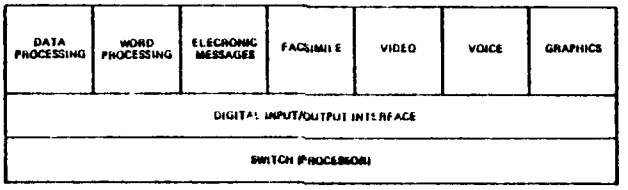


Figure 2. Digital Interconnections Between Office Equipments and a Controller

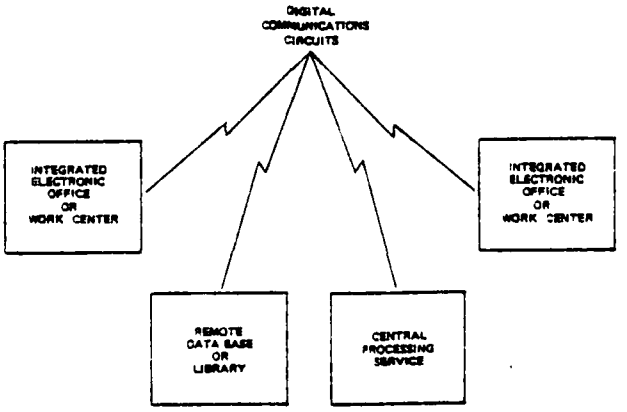


Figure 3. Dispersed or Distributed Office Functions Connected by Digital Communications Circuits

The definition provided by these three figures establishes a basis for Task 2 wherein high-level planners among the DoD MILDEPS and Agencies were queried as to the status of their telecommunications requirements determinations with regard to the possible adoption of several, if not all, of the new inter-office information exchange technologies.

The study concludes that the mainstream technologies of electronic mail transfer, communicating word processors, facsimile, micrographics and teleconferencing will have become well entrenched as common forms of information exchange between offices and Agencies of the DoD by the 1990s.

It is suspected that many offices in DoD, in addition to special systems which are already officially in place, now make use of most of the modern technologies unofficially as a matter of "convenience". Examples of DoD "convenience" are facsimile machines and the employment of ARPA and other computer networks to exchange electronic mail, i.e., messages between individuals.

Teleconferencing techniques, particularly audio, narrow band video, and computer conferencing will continue to be employed by industry, and incorporation within DoD will greatly increase.

Computer graphics, a technique to present information to decision-makers in highly concentrated form, is considered to be the fastest growing technology examined in this report.

Computer output mirofilm which may be digitally stored and transmitted electronically, will become more actively employed by DoD as the requirement increases to reduce or eliminate "paper" files.

2.2.3 Comments on Task 1 Study. Application of many of the office technologies discussed in the report has traditionally been in the area of office services in support of administrative functions. This is especially true for word processors, facsimile, office copiers, computer output microfilm and the various forms of teleconferencing. Computer graphics has generally supported technical and design work while electronic funds transfer and computer aided instruction have each resided in their own niche. Communicating or intelligent copiers are a new technology, just coming onto the scene and are not fitted firmly into any particular application. The pervading theme of the report is that computers and computer technology are paramount to development of information processing and handling systems of the future.

The concepts involved in bringing about an integrated electronic office through digitizing the input and output of information processing and distribution equipments and then using a controller, a computer, to tie everything together and direct the interface are discussed and illustrated. Concepts must evolve in an orderly fashion with improved understanding by the "users" in order to achieve the ultimate goal of an electronic integrated office system which is cost effective and highly productive. Likewise, the disciplines currently applied to data processing must be applied to the computer controlled office equipments. The ideal situation would be for the devices to be transparent to the operator but for this to be so there must be an involvement of computer personnel, programmers, systems analysts, and data base managers. Presently, the more sophisticated word processors come with their own software packages, and some hardware features, which are better understood by computer programmers than by word processing personnel. The design emphasis should address the question, How do we make the job easier for the office staff personnel (i.e., the user) and not for the computer programmer?

The development of the integrated electronic office should occur in an evolutionary manner as the need is perceived, so as not to obsolete the past investments at a non-economical rate. The movement towards automation of information processing and handling systems will be dictated by the necessity to reduce exchange delays of important and perishable information.

The move towards office automation has already started in both industry and government. It will accelerate as the costs associated with personnel continue to increase while those associated with hardware and communications continue to decrease.

Personnel, both the manager-users of the integrated electronic office and the system operators, will be a major factor in the speed with which the new technologies are acquired and the success of the systems after they are in place.

The research conducted has led to the observation that there are, for the most part, no industry-wide standards for protocols to be applied within the interfaces between equipments. It is understandable that such diverse technologies as word processing and facsimile, each of which developed as stand-alone technologies, have given little or no thought to the interfacing of these

technologies which is now taking place. However, even within a single technology the same interface problems exist. Front-end or in-line processors have been developed to overcome some of the problems but not all. Continuing development of microprocessors and their incorporation into equipment communications interfaces to overcome these incompatibility problems are bound to help, but greater attention is needed in this area. If universal communications compatibility is not achieved between every model of each of the represented technologies, then consideration must be given at time of systems procurement to acquiring systems and equipments which are compatible or interoperable. Close coordination between those individuals who acquire and use the systems and experts in the field of communications is a must.

2.3 Summary of Task 2 Results. This section of the report presents, in concise form, a summary of Task 2 study results. A more detailed discussion of these results appears in Appendix B.

2.3.1 Context of Task 2 Study. Task 2, Identification of Telecommunications Demands by DoD Services with Regard to Nontactical Communications Needs, was conducted by MAR, Incorporated. The study effort is a compilation of responses resulting from interviewing selected DoD MILDEPS and Agency representatives regarding their projections of Office Automation technology implementation impact on the DCS communications demands. The seven DoD MILDEPS and Agencies represented include Army, Navy, Air Force, Marine Corps, DCA Staff, Defense Intelligence Agency, and Defense Logistics Agency. Additionally, one non-DoD Agency, the U.S. Coast Guard, was surveyed.

2.3.2 Significant findings of Task 2 study. The major findings of Task 2 are that:

a. Definitive policy and long range plans for DoD agencies are lacking due to the: uncertainty concerning available technology from industry and methods of implementing office automation; expected future directives from the Federal Government; concern for potential conflicts in jurisdiction; rapid obsolescence of equipment; lack of knowledge regarding full utilization/exploitation of system capabilities; and office automation projects are seen as application specific.

b. Quantitative future communications requirements are lacking since there is no overall operation concept. Until experience is gained

with office automation equipments and traffic patterns within and between local and remote offices, requirements cannot be determined.

c. Projections indicate that as office automation is achieved a greater amount of data will be stored in electronic digital form. The implication of data in digitized form suggests electronic transfer and less dependence on messages, facsimile, mail, telephone, or trips. Thus the volume of interorganizational traffic via office automation will be heavily impacted by local administrative decisions concerning release authority and access to interorganizational data files.

Figure 4 is a summary of projected use of office automation technology for various military functions. Examination of this figure shows that communicating word processors and electronic mail are projected to be most used. Portable communications/radio paging, computer conferencing, audio teleconferencing, computer assisted instruction, and electronic blackboard are projected to be used by the smallest number of activities. Further, Figure 4 shows that Research & Development, Administration, and Documentation & Publications are projected to use a greater number of office automation technologies, whereas Medical, Joint Transportation Board, and Security do not anticipate any projected use of office automation technology.

2.3.3 Comments. The Task 2 report comments that the lack of requirements definition, quantitative communications load factors and overall interagency coordination prohibits the forming of any meaningful conclusions regarding impact of traffic loads on the DCS network.

2.4 Implications for DCA Requirements Definition.

The Agencies and MILDEPS are thinking seriously about automating their various administrative functions but have not yet reached precise requirements determinations. They are still trying out and experimenting with ideas.

Predominately mentioned technologies are: (1) exchange of message mail and rapid interaction to this information, (2) electronic word processing (a form of message exchange), (3) access to centrally located data bases, (4) exchange of micrographics, (5) electronic document printing systems, (6) some

FUNCTION \ TECHNOLOGY	AUDIO (VOICE) CONFERENCING	VIDEO CONFERENCING	COMPUTER CONFERENCING	ELECTRONIC MAIL	FACSIMILE	COMMUNICATING WORD PROCESSING	COMMUNICATING COPIERS	COMMUNICATIONS PAGING/PORTABLE	MICROGRAPHICS	ELECTRONIC FUNDS TRANSFER	COMPUTER ASSISTED INSTRUCTION	MANAGEMENT INFO SYSTEM	ELECTRONIC BLACKBOARD
LOGISTICS		●		●		●			●				
PERSONNEL				●		●	●		●				
MEDICAL													
ADMINISTRATION		●		●		●	●		●	●		●	
SECURITY													
INTELLIGENCE				●	●	●						●	
DOCUMENTS AND PUBLICATIONS				●	●	●	●		●				
RESEARCH AND DEVELOPMENT	●	●	●	●		●				●	●	●	●
COMPTROLLER						●							
JOINT TRANSPORT BOARD													

Figure 4. DoD Projected Use of Office Automation Technology for Military Functions

requirements for teleconferencing, and (7) a few highly specialized services such as electronic blackboards.

There are no real quantitative data to help size the probable 1990 - 1995 traffic load on DCS. DoD is going to need 300 baud lines, 9600 baud lines, high capacity lines (56 Kbit) to accommodate rapid transmission between closely located offices and to transmit micrographics and remote document reproduction sites, and a few video capacity channels (1 - 4 mHz) to accommodate video teleconferencing.

There is no doubt that the MILDEPS are actively planning for the needs of individual offices. At least one, the Navy's Technical Office Automation and Communications System (TOFACS), is a model of an ideal Office of the Future information handling system. Unfortunately, in fact-finding interviews, the MILDEPS and Agencies were seen in a very fluid stage in systems planning. Most of the efforts are in a pilot study phase to explore the possibilities of office automation. It very well may be that in their description of what is going on, the persons interviewed were being rather expansive in their claims for future capabilities requirements.

Agencies such as Defense Logistics Agency and Defense Intelligence Agency appear to recognize a legitimate need for their remotely located offices to be able to access central data bases and to communicate.

What becomes clear is that planning for the future impact of intercommunicating office automation systems is still parochial among the agencies and services. There is very little Agency/MILDEP coordination in telecommunications requirements definition, a situation in an overall policy sense which bodes ill for DCA. Compiling an exhaustive list of all the grass roots planning currently going on, adding up the traffic totals, and deciding the size of the supporting telecommunications network which should be provided seems an impossible task at present.

The issue, rather, seems to be that of providing the Agency/Tri-Service telecommunications planning community with a structure for defining future requirements, using some sort of common basis for calculations.

Since the results of Task 2 seem to indicate that most of the automated office technology planning (particularly with regard to intercommunicating office technology efforts) is in the pilot study and planning stages, one might

conclude that the time lag between civilian sector adaptation and DoD adaptation is more likely ten years than five. Most of the civilian sector enterprises reached the "pilot study" phase in the early 1970s for many of the office automation technologies.

The civilian sector will probably asymptote in the early 1990s with regard to present technology demands and attendant communications requirements. The extrapolation of an asymptote of DoD automation and communication requirements by the year 2000, which would be a reasonable thing to do, may not be very accurate due to the fact that technologies change much faster than ten year cycles and may depart in completely unanticipated directions which offer new approaches and unpredictable growth.

Thus, a three-fold conclusion may be drawn: (1) DoD has very little idea of what traffic demands it may impose in the 1990s, (2) civilian networks will be prepared and more than happy to accommodate the unanticipated overload of DCS networks at a price. This latter is a safety-valve which will absolve all DoD telecommunications planners from short-fall predictions, and (3) most of the systems alluded to in Task 2 are vendor-proposed, as opposed to any serious system engineering efforts on the part of DoD communications community.

3.0 DATA SYNTHESIS OF PREVIOUS STUDIES

3.1 Synthesis Strategy. Two previous studies were performed. One identified the predominate information exchange technologies associated with future automated offices as reflected in the civil sector. The second, on the basis of direct contacts with the service telecommunications planners, determined the extent to which current DoD planning anticipates a probable growth in telecommunications demands due to the incorporation of these new office techniques which are already proliferating in the civil sector.

The key findings of Task 1 and Task 2 are as follows: (1) In spite of at least a ten year history of private industry exploitation of modern office technology and development of associated telecommunications capabilities, there is very little evidence of formal and coordinated DoD planning to exploit the new office technologies. What is being incorporated of the new office technology is occurring at grass roots levels and is often being explored by individual commands. (2) The design and implementation of DoD communications systems such as AUTODIN II may be seriously out of date because the design has probably been frozen and the traffic demand growth possibilities due to an exponential rise in new technologies may not have been anticipated. (3) Mechanisms to formulate telecommunications requirements definitions due to the new technologies simply do not appear to exist in DoD Tri-Service Staff planning in any significant way and a possible conclusion is that there is a general insensitivity to this thrust toward modernization of the administrative arms of the MILDEPS, perhaps because of the intense preoccupation in solving the strategic and tactical command and control communication problems, which, ironically, might also be somewhat ameliorated by the adoption of several of the recent advances in information handling and processing technologies. (4) Even if there were an intensive thrust toward sizing and defining the telecommunications requirements of the various services within DoD, due to modern office technology, these Departments and Agencies may require the assistance of the DCA, with its communications expertise, to help in requirements determination. (5) Fortunately, there is a safety valve which would soften the consequences of incomplete DoD planning for the future adoption of modern office technology. It has already been predicted that the AUTODIN II network will be overloaded by automated office information exchange demands by 1985 [3]. The safety valve is to buy the additional service required from the civilian

common carriers as the needs develop. (6) Traffic projections as to the anticipated load on DCA networks due to modern office automation technologies are not forthcoming, simply because hard data are not available.

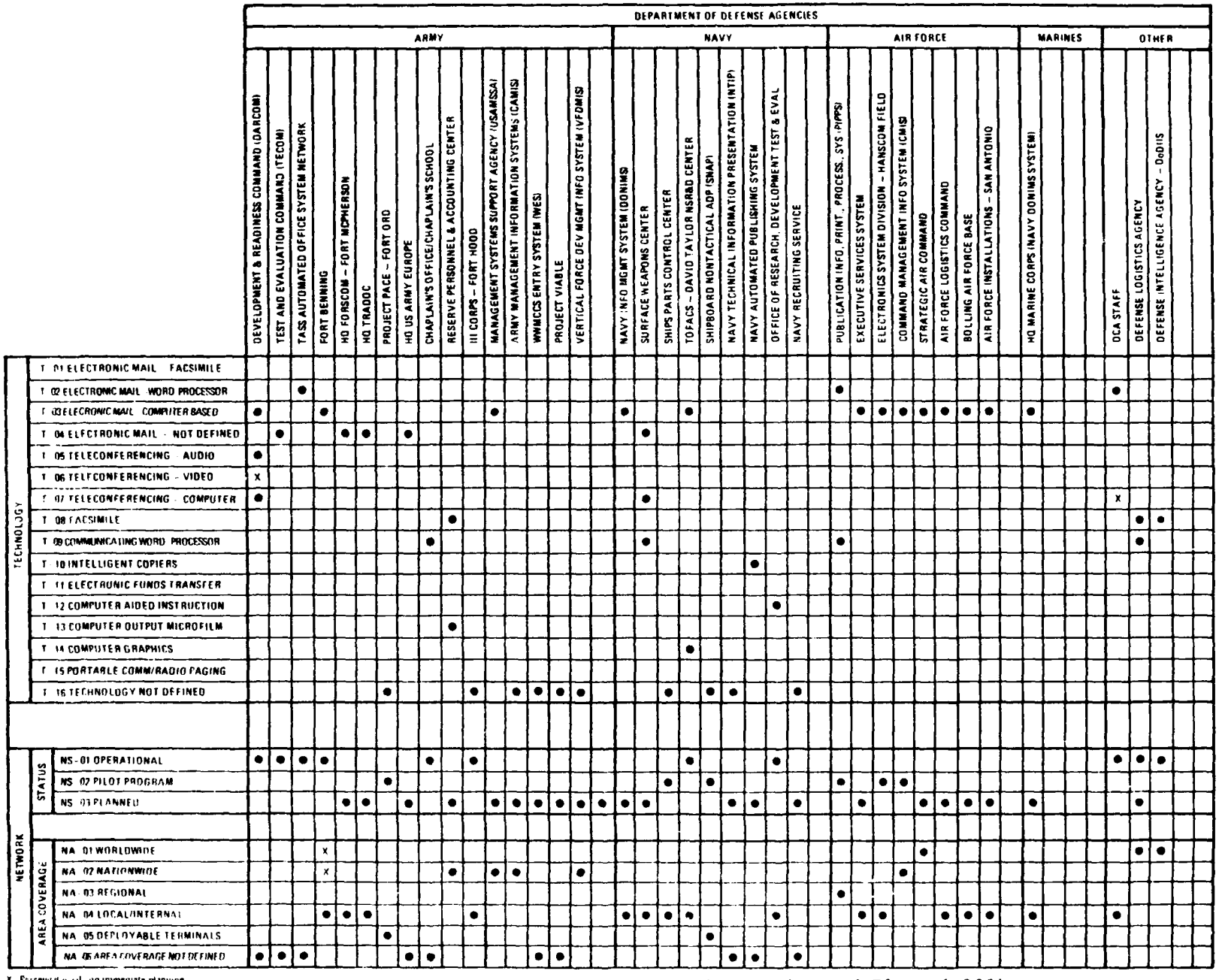
The present Task 3 study synthesizes the results of the two previous studies and reports the possible implications of these findings for future telecommunications network design to the Defense Communications Engineering Center of the Defense Communications Agency.

3.2 Currently Identified Communication Requirements. The purpose of this section of the report is to discuss and further analyze the communication requirements which were identified in the Task 2 report.

3.2.1 Analysis of identified requirements. Figures 5 and 6 were derived from the text of the Task 2 report and analyze the information from the viewpoint of the technologies described and reported upon in the Task 1 report.

Figure 5 presents a list of existing and planned networks and installations which support office automation within the DoD and correlates them with the recognized technologies. The DoD agencies which have been identified as operating or planning office automation installations are listed in columns across the top of the matrix. Placement of dots within a column opposite a listed technology indicates that the agency is employing/planning to employ that technology in its office automation efforts. Placement of dots in a column opposite a Network Status row entry indicates the status of the agency's automation effort; placement of a dot in the Network Area Coverage portion of the matrix shows the existing/planned extent of the communications network existing/required to support that agency's office automation. Figure 6 was derived from Figure 5 and examines network status and network area coverage as employed with and in support of each of the technologies. The figures reveal that there is some recognition of, and requirement for, office automation existing in the MILDEPS and certain other Agencies of the DoD. (This was of course stated in the Task 2 report, but the information was analyzed and presented in a different format.)

An alpha-numerical designator has been attached to each of the elements appearing in Figures 5 and 6 solely for the purpose of establishing a more positive identification of those elements which might otherwise be confused as



x Perceived need, no immediate planning

Figure 5. Correlation of Technologies with Existing and Planned Office Automation Efforts Within the Department of Defense

		NETWORK									
		STATUS				AREA COVERAGE					
		NS–01 OPERATIONAL	NS–02 PILOT PROGRAM	NS–03 PLANNED		NA–01 WORLDWIDE	NA–02 NATIONWIDE	NA–03 REGIONAL	NA–04 LOCAL/INTERNAL	NA–05 DEPLOYABLE TERMINALS	NA–06 AREA COVERAGE NOT DEFINED
TECHNOLOGY	T–01 ELECTRONIC MAIL – FACSIMILE	0	0	0		0	0	0	0	0	0
	T–02 ELECTRONIC MAIL – WORD PROCESSOR	2	1	0		0	0	1	1	0	1
	T–03 ELECTRONIC MAIL – COMPUTER BASED	3	2	8		1	2	0	9	0	1
	T–04 ELECTRONIC MAIL – NOT DEFINED	1	1	3		0	0	0	3	0	2
	T–05 TELECONFERENCING – AUDIO	1	0	0		0	0	0	0	0	1
	T–06 TELECONFERENCING – VIDEO	0	0	0		0	0	0	0	0	0
	T–07 TELECONFERENCING – COMPUTER	1	0	1		1	1	0	0	0	0
	T–08 FACSIMILE	2	0	1		1	0	0	1	0	1
	T–09 COMMUNICATING WORD PROCESSORS	1	1	2		1	0	1	1	0	1
	T–10 INTELLIGENT COPIERS	0	0	1		0	0	0	0	0	1
	T–11 ELECTRONIC FUNDS TRANSFER	0	0	0		0	0	0	0	0	0
	T–12 COMPUTER AIDED INSTRUCTION	1	0	0		0	0	0	1	0	0
	T–13 COMPUTER OUTPUT MICROFILM	0	0	1		0	1	0	0	0	0
	T–14 COMPUTER GRAPHICS	1	0	0		0	0	0	1	0	0
	T–15 PORTABLE COMM/RADIO PAGING	0	0	0		0	0	0	0	0	0
	T–16 TECHNOLOGY NOT DEFINED	1	3	6		0	2	0	2	2	4

Figure 6. Network Status and Area Coverage by Applicable Technology

a result of their basic similarity. The term "Not Defined" is appended to three of the elements: T-04 Electronic Mail-Not Defined; T-16 Technology Not Defined; and NA-06 Network Area Coverage Not Defined. Technology and network information which was extracted from the Task 2 report and which could not clearly be identified as fitting into one of the other elements was entered into the "Not Defined" elements. The users and potential users of the technologies may not have defined their own needs, or their intentions may not have been ascertained by the interviewer who collected the data.

Placement of a dot in the T-04 Electronic Mail - Not Defined row in the maxtrix indicates that electronic mail was mentioned but not clearly associated with either T-01, T-02 or T-03. In some instances an entry was made in the T-04 row when it was implied (but not defined) that the electronic mail system is/will be computer based. Likewise, entries were made in row T-16 Technology Not Defined when office automation was discussed in general terms and not precisely defined as to Technology.

Entries in the NA-06 Area Coverage Not Defined row could in some instances be assigned to another Area Coverage row if this analyst had a better knowledge of the organization and geographical distribution of all the DoD Agencies.

Figure 6 is next examined from the viewpoint of each of the technologies. In Table 1 the technologies are listed along with the applicable network status elements, the network area coverage elements, and the quantity of systems or installations falling into each element. The information from Table 1 is summarized in Table 2 and clearly shows that the status of automated information transfer networks exists primarily in pilot programs and planning rather than as operational networks. As regards area coverage of the existing and planned networks NA-04 Local/Internal and NA-06 Not Defined are the clear leaders.

Figures 5 and 6 and Tables 1 and 2 contain significant information, but they do not reflect the existence of certain planning bodies within DoD which are newly formed for the purpose of pursuing office automation trends and requirements. The planning bodies do not appear in the figures because they do not now operate or have stated plans for operating networks. An example of such a planning group is the Navy Laboratories Computer Committee (NLCC) Integrated Automated Office Systems Working Group which held its first meeting

Table 1. Technologies Vs. Networks

T-01 Electronic Mail - Facsimile

No existing or planned application

T-02 Electronic Mail - Word Processor

Network Status	
NS-01 Operational	2
NS-02 Pilot Program	1
	3
Network Area Coverage	
NA-03 Regional	1
NA-04 Local/Internal	1
NA-06 Not Defined	1
	3

T-03 Electronic Mail - Computer Based

Network Status	
NS-01 Operational	3
NS-02 Pilot Program	2
NS-03 Planned	8
	13
Network Area Coverage	
NA-01 Worldwide	1
NA-02 Nationwide	2
NA-04 Local/Internal	9
NA-06 Not Defined	1
	13

T-04 Electronic Mail - Not Defined

Network Status	
NS-01 Operational	1
NS-02 Pilot Program	1
NS-03 Planned	3
	5
Network Area Coverage	
NA-04 Local/Internal	3
NA-06 Not Defined	2
	5

T-05 Teleconferencing - Audio

Network Status	
NS-01 Operational	1
	1

Table 1. Technologies Vs. Networks (Continued)

T-05 - Teleconferencing - Audio (Continued)

Network Area Coverage	
NA-06 Not Defined	1
	1

T-06 Teleconferencing - Video

No existing or planned application.

T-07 Teleconferencing - Computer

Network Status	
NS-01 Operational	1
NS-03 Planned	1
	2
Network Area Coverage	
NA-04 Local/Internal	1
NA-06 Not Defined	1
	2

T-08 Facsimile

Network Status	
NS-01 Operational	2
NS-03 Planned	1
	3
Network Area Coverage	
NA-01 Worldwide	2
NA-02 National	1
	3

T-09 Communicating Word Processors

Network Status	
NS-01 Operational	1
NS-02 Pilot Program	1
NS-03 Planned	2
	4
Network Area Coverage	
NA-01 Worldwide	1
NA-03 Regional	1
NA-04 Local/Internal	1
NA-06 Not Defined	1
	4

Table 1. Technologies Vs. Networks (Continued)

T-10 Intelligent Copiers

Network Status
NS-03 Planned — 1/1

Network Area Coverage
NA-06 Not Defined — 1/1

T-11 Electronic Funds Transfer
No existing or planned application

T-12 Computer Aided Instruction

Network Status
NS-01 Operational — 1/1

Network Area Coverage
NA-04 Local/Internal — 1/1

T-13 Computer Output Microfilm

Network Status
NS-03 Planned — 1/1

Network Area Coverage
NA-02 National — 1/1

T-14 Computer Graphics

Network Status
NS-01 Operational — 1/1

Network Area Coverage
NA-04 Local/Internal — 1/1

T-15 Portable Communications/Radio Paging

No existing or planned application

Table 1. Technologies Vs. Networks (Continued)

T-16 Technology Not Defined	
Network Status	
NS-01 Operational	1
NS-02 Pilot Program	3
NS-03 Planned	6
	10
Network Area Coverage	
NA-02 Nationwide	2
NA-04 Local/Internal	2
NA-05 Deployable Terminals	2
NA-06 Not Defined	4
	10

Table 2. Network Totals

Network Status		Quantity	Percent
NS-01 Operational		14	31
NS-02 Pilot Program		8	18
NS-03 Planned		23	51
	Totals	45	100

Network Area Coverage		Quantity	Percent
NA-01 Worldwide		4	8
NA-02 Nationwide		6	14
NA-03 Regional		2	4.5
NA-04 Local/Internal		19	42
NA-05 Deployable Terminals		2	4.5
NA-06 Not Defined		12	27
	Totals	45	100.0

29-30 October 1980 and operates under a rather broad charter. It is considered to be quite possible that other such planning groups exist within the DoD or that their inception is forthcoming.

At first examination it would appear that those networks with area coverage defined as NA-04 Local/Internal would not be expected to have any impact on DCA planning for future circuit and network requirements. However, it should be kept in mind that there is a possibility (even a probability) that users of these local/internal installations will in the future perceive a requirement to interconnect with other, external, systems. The mere fact that their internal operations are automated and they have or develop an associa-

tion with another automated entity will be the necessary factor for developing an external communications requirement.

3.3 Gaps in Technological Application Definition

The results of the Task 2 study indicate that the MILDEPS and Agencies are engaged in a number of sporadic and uncoordinated planning efforts with regard to automated office implementation.

Even though it is understandable that such planning as apparently does exist within DoD has not reached the state of communication traffic requirements definition, there appear to be some real gaps in defining functional applications for the new technologies. The following sections touch briefly on some of these.

3.3.1 Present emphasis. To summarize the current automation planning emphasis, it appears that thinking of planners centers primarily on electronic mail transfer in various forms and, to some extent, on word processing. There is effort being expended toward what we have categorized as "undefined technologies" which probably represent attempts to automate internal office functions for special, individual requirements of a given Agency or MILDEP office and may not impose a telecommunications load on the DCS system. (See Figures 5 and 6.)

3.3.2 Overlooked Potential Automation Application. The extent to which potential automation applications for the new technologies may be being overlooked in DoD planning can be appreciated when it is realized that the Task 2 study survey uncovered a relatively small number of automation applications within DoD in relation to applications which are possible.

For example, most, if not all, of the office data exchange technologies identified in Table 1 can be applied to the various personnel management functions required to feed, clothe, house, equip, pay, train, deploy, medically treat and separate military personnel. Or, as another example, to the design, procurement, deployment, maintenance, and repair (updating) of military equipment.

Thus the sampling undertaken in the Task 2 study was certainly not exhaustive. Nor could such a sampling approach ever be exhaustive.

It is estimated that what will be happening in DoD to implement office automation technologies in the next 15 - 20 years will be greater by a factor of at least 10 to 100 than was indicated by the present survey.

3.4 Implications for DCS Traffic Load Planning.

The results of the series of studies reported here provide DCA with valuable qualitative information about the problems within DoD in arriving at a requirements definition concerning trends in office automation as these affect the determination of an accurate load projection for the DCS network into the 1990s.

What has become clear through experience is that the restricted sampling possibilities available to anyone below the highest level of DoD and their access to exhaustive and complete information, cannot size future communication loads due to office automation trends in any quantitative way.

Most importantly, it also becomes clear that a DCA sponsored effort has very little possibility of asking DoD MILDEPS and Agencies about projected traffic loads on the DCS networks with the hope of getting any definitive replies, that is, enough information to enumerate all the Commands who might use the new technologies, their anticipated traffic load, and to add up the total bit figures. In all probability (as is borne out in the present study) they don't fully understand the implications of the new technologies, haven't considered the question in any depth, haven't planned for them, etc. And, even if they have, the information would not be completely forthcoming because of the level from which the questions are asked.

The problem seems intractable with the approach which has been followed in the present series of studies. Another, possibly workable, approach is suggested in the Conclusions and Recommendations section of this report.

Sizing traffic load statistics in any empirical way is not possible at this time.

3.5 Issues to Consider in Network Design

Beyond the question of traffic volumes associated with DoD office automation, which are not possible to determine at this time, a number of qualitative issues reflecting a DCS network design are suggested from the results of the foregoing series of studies.

These issues are identified so as to provide a list of additional considerations to be taken into account in any design effort to accommodate the DCS network to growing office automation trends.

3.5.1 Responsiveness. DoD communications systems presently are not conditioned to rapid response, except in certain strategic and tactical situations, to handle immediate query-response transactions. Because of normal delay, it is probably safe to assume in 1980 that the total transactions in any one day consist of queries, since the response will normally be forthcoming in a day or two, perhaps within 30 days.

However, with the ease of information exchange and interaction between participants, offered by new office technologies, the query-response transaction could occur within the same day, or even within the same busy hour. Thus, using present methods of calculation, the total daily traffic load could be underestimated by a factor of X2. In other words, real-time communications over networks, a situation which is not currently typical, will become a highly significant factor to consider by the 1990s.

3.5.2 Security of Information. It is necessary to provide communications security to strategic and tactical information. Administrative information passed back and forth by DoD offices in the years to come will surely be constrained by the same necessity for security, if not privacy. Encrypted information at high data rates over communications lines would be almost useless without powerful error detection and correction codes being applied. Error detection and correction codes can eat up as much as half the available bandwidth to accomplish the task of accurate information transfer. So, whatever the estimated bit per second load is determined to be for automated office information (in the clear), it would be wise to double the estimate to take into account security requirements.

3.5.3 Terminal Authentication. The new office technology undoubtedly detracts from the ability to know with whom one is speaking in critical transactions. It is possible to imagine many pages of sensitive information being transferred to an unauthorized recipient or for an unauthorized questioner to elicit a great deal of information to which he is not entitled. The terminal is completely impersonal, as opposed to the old days of communications when the CW operator could identify the "fist" of the sender.

Computer fraud is a challenging and compelling science, if the stakes are high enough, for those persons who are as smart as, if not smarter, than network designers. Other than perfunctory authentication codes which may be applied, there is very little that can be done except the complete encryption of substantive information. The problem is easy enough to solve in a technical sense, but it is difficult to overcome the psychological problem of the reluctance of highly placed individuals to transmit classified or proprietary information "in the blind" over terminals without the assurance of seeing the recipient face to face and recognizing him/her.

3.5.4 Overseas deployment of office technologies. Future deployment of forces and offices which have undergone automation to forward/overseas/at sea locations indicates a potential requirement for satellite links between users, data bases, central processing facilities, and so forth.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions. Several major problems have been identified as a result of this series of three studies. A number of conclusions may be drawn from the series of reports and are stated below although they are discussed in greater detail at other places in the report.

4.1.1 Conclusions (General)

a. Technical sophistication of office automation equipment has progressed to a point where capabilities represented are highly attractive to users and certain cost savings are becoming obvious.

b. Equipment manufacturers are hesitant to design "universal" communication interfaces to other - brand equipments for fear of losing their corner of the market. Users, as a whole, are unfamiliar with the technical aspects of the equipment they are buying and are hesitant to force suppliers to provide interoperability to "other" systems.

c. DoD potential users are widespread, although few quantitative requirements are available. Some "local areas of aggressive planning and implementation" do exist.

d. No DoD-wide planning exists.

4.1.2 Conclusions (Discussion) (keyed to items in 4.1.1)

a. The dots (•) of Figure 5 of this report show the relationship between selected office technologies and existing or firm planning estimates of various DoD Agencies. The dots show a significant involvement now in each of the various technology areas of concern. The x entries of Figure 5 show forthcoming plans to utilize the various technologies. It can be seen that across the board in DoD, activity already is creating a communication demand. Ref 1 describes the technical aspects of the resultant communication demand for each technology area.

In general, the communication demand is unique in that it has two somewhat new characteristics, extremely high volumes and fast transmission requirements to allow for real time user interactions. This is exemplified by electronic mail by facsimile and by video teleconferencing.

Additionally, the new communications demand is not for communications services at a Communication Center but for service at the individual's desk or conference room. Aggregating communication services at a Communication Center does not meet the emerging need.

b. Due to the expense of the hardware involved, many users are purchasing equipment gradually. Equipment manufacturers do not design their hardware to interoperate with competitors' equipment as this would weaken follow-on sales. The result is an overt

trend to avoid interoperable systems at this time. It is expected that, without DoD action, in the 1995 time frame when the market place is more competitive, some interoperability will naturally occur.

Due to the inherent military requirement for interoperability, there is need now for the interoperability requirement to be forced upon manufacturers before the equipment population makes it impractical. Consequently, this implies a need for interface standards.

c. The technologies discussed briefly in Appendix 1 and in more detail in Ref 1 are generally in an early but high growth stage for non-DoD applications. Acceptance and utilization are lagging in DoD, although there already is motion within the DoD community to acquire these capabilities. This is documented in Ref 2. Considering the usual DoD delay in employing advancing technologies, real DoD growth has not yet started. Specifically, DoD user desires are clear and will result in increasing demands in the near future. Imbedded in this requirement is a massive demand for telecommunications.

d. Discussion. A possible solution to all or some of these problems is suggested by an article in Dimensions/NBS* of October 1980 [4]. Written by Shirley Radack in the Office of the Director, National Bureau of Standards Institute for Computer Sciences and Technology (ICST), the article identifies some of the same problems outlined in this series of reports as regards lack of system compatibility and interfaces, and lack of adequate planning by government agencies for office automation. Although the article does not address quantitative communications requirements in support of office automation it does outline the work being done by the ICST in addressing some of the user needs - to achieve better acquisition, management, and use of computer, office system, and network resources. ICST is responsible, under the Brooks Act, for developing Federal ADP standards, providing technical assistance to Federal agencies, and supporting computer science research. In the computer-based office systems area, ICST will develop standards to improve communications and integration and to ensure document interchange between automated offices. Plans include standards for message and file formats, text editing and document formatting commands, and message processing commands.

ICST is also planning several guidelines to aid Federal managers and users in planning for, selecting, and evaluating computer-based office systems. The first of these guides has been completed. The methodology described in the guide is expected to help agencies determine the feasibility of implementing office automation systems. Guidance on Requirements Analysis for Office Automation Systems was developed to help Federal agencies conduct thorough requirements analyses and procurement justifications for office automation systems.

*Dimensions/NBS is an official publication of the National Bureau of Standards.

The recommended methodology involves the collection of productivity data relating directly to the workload of both professional and support staffs. Data are collected through interviews, questionnaires, and observations by a team selected to carry out the study. There are five key steps in the recommended analysis process: determining baseline office productivity; designing the office automation system; developing functional specifications; assessing the cost justification for implementing the office automation system; and conducting post-implementation audits.

It is apparent that the above-described five-step methodology can, with perhaps some modification or expansion, provide planning figures for communications network loading in addition to the procurement functions.

In view of the lack of quantitative figures resulting from this series of studies in spite of the considerable effort expended it would appear that a greatly expanded effort must be initiated in order to educate potential users of office automation to its possibilities and to develop near and long-term communication requirements. This expanded effort would appear to be continuing in nature rather than a one-time occurrence.

4.2 Recommendations. One possible recommendation to provide a solution to the identified problems is that a working group be formed by the DoD to pursue the subject of office automation and resulting communications requirements. In order for the working group to receive the necessary recognition and support it should be placed at the level of the Office of the Secretary of Defense (OSD). Membership of the working group should be drawn from all interested DoD agencies with the Chairman being selected from a position external to those bodies and reporting to the Secretary of Defense. The working group should apply the five step methodology outlined above to all of the technological automation areas throughout all levels of the DoD, recognizing that it would be necessary to develop (or discover) means for applying the analyses to technologies other than ADP.

Development of similar working groups in each of the DoD MILDEPS and Agencies is indicated as the prime point of interface between the OSD working group and the MILDEPS and Agencies.

Necessary steps leading to the desired result, quantified circuit/network requirements data availability, are seen as:

a. Establish the DoD-level working group, define its duties and responsibilities, and recruit/assign members and chairman.

b. Promulgate initial directives to DoD MILDEPS and Agencies advising of the existence of the working group and requiring establishment of corresponding groups in each MILDEP and Agency.

c. Provide training/education medium to assure that all working group members are operating from a common knowledge base as regards trends in office automation, the technologies concerned, successes and failures experienced by other governmental agencies and civilian entities, and existing/planned efforts in office automation throughout the DoD.

d. Establish a working relationship with other Federal Government agencies which are involved in office automation efforts, the provision of telecommunications services, and the monitoring of such efforts. Agencies which come to mind are The National Bureau of Standards, U.S. Department of Commerce; the Federal Telecommunications System; and the General Acounting Office.

e. Provide essential communications networks to interconnect the working groups, probably in the form of a computer based message/electronic mail/conferencing system.

f. Provide education medium to acquaint potential managers and users of office automation in each MILDEP and Agency with the developing technologies.

g. Conduct an evaluation in each MILDEP and Agency to determine potential office automation requirements and develop priorities for performing the automation. This step would accomplish several positive procedures:

(1) *The MILDEP or Agency Head would for the first time have an* overall view of office automation requirements and be able to identify which offices/departments will or will not be automated.

(2) Offices/departments will proceed in an orderly manner with automation which will lend itself to near and long term integration into a defined overall automation requirement. Procurement of vendor-oriented systems which lack potential for compatibility and interoperability will be stopped, heading off a future problem of almost insurmountable magnitude. The Task 2 report identifies only thirty-some activities and systems in existence or planned but these are the officially recognized systems and do not take into account the many non-official systems nor the exponential growth which may be expected within the very near future. As regards management and operation of systems, thought must be given to growing problems caused by the new technologies. At one time hardware failures were essentially the only cause for a communication network to fail ("crash") but now software failures, in either the network itself or in a connected system, often cause a "crash". Development of extremely complex hybrid networks increases the difficulty in managing them and diagnosing faults and failures [5].

(3) Technologies to be incorporated into the various offices/departments will be identified and the sizes of the systems will be identified. The potential communications requirements can be identified as to type (i.e., digital or analog), bandwidth, expected volume, location of terminals, individual circuit and trunk loading, and special requirements. Comparison of newly developed data may then be compared against existing network capabilities and shortfalls identified in some detail.

When performing the above-described analyses it will, of course, not be necessary to go to the grass roots of every office in every MILDEP and Agency. Data from a personnel office processing 2,000 personnel a month can readily be extrapolated to provide data for another personnel office serving more or fewer personnel provided that their technologies and procedures are the same or very similar.

5.0 REFERENCES

[1] NOSC TN882, Telecommunications Services Required by Distributed and Interconnected Office Centers, by TL Comport, 20 July 1980.

[2] MAR, Inc., Technical Report No. 257, Identification of Telecommunication Demands by the DoD Services With Regard to Nontactical Communication Needs, December 1980

[3] NELC TN 3269, Integrated AUTODIN System Architecture (IASA) Telecommunications Forecast 1980-1990, volume 1, by TL Comport, 14 October 1976.

[4] Radack, S., A Look at Federal Office Automation, Dimensions/NBS, October 1980, page 2.

[5] EDWARDS, M., An Exclusive Interview with James Martin, Communications News, January 1981, page 42.

APPENDIX A: SUMMARY OF NOSC TN882, TELECOMMUNICATIONS SERVICES REQUIRED BY DISTRIBUTED AND INTERCONNECTED OFFICE CENTERS, 20 JULY 1980.

The purpose of this report is to present and synthesize the results of an analysis of available literature which projects the application of communications and computer based technology to information handling and transfer systems of the future so as to alleviate the labor intensive, manual nature of such work. The primary sources of information were Technical Reports, articles appearing in trade journals, and several popular books which foresee future trends in the networking of information such as The Wired Society [1] and The Network Nation [2]. Specifically, the report attempts to foresee trends in present and developing technologies which may impact on the automation capabilities incorporated into future DoD information centers and, hence, on the planning for communication networks that will have to be provided by the Defense Communication System (DCS) to interconnect them.

BACKGROUND

The Defense Communications Agency (DCA), in previous studies, has explored possible applications within DoD for facsimile and the various forms of teleconferencing [3] [4], which would appear to be necessary adjuncts to "automated information centers". This report expands on that information and examines other technologies which will have important roles to play in future information handling and transfer applications. The technologies examined are: Electronic Mail, Teleconferencing, Facsimile, Word Processors, Intelligent Copies, Electronic Funds Transfer, Computer Aided Instruction, Computer Output Microfilm, Computer Graphics, and Portable Communications/Radio Paging.

TIME FRAME

The (nominal) time-frame for this study is fifteen years into the future. It recognizes that realistic projections of technology are probably valid for only about five years, based upon what exists now at the forefront

[1]. Martin, J, The Wired Society, Prentice-Hall, 1978.

[2]. Hiltz, SR, and Turoff, M, The Network Nation, Addison-Wesley, 1978.

[3]. NOSC TN524, Facsimile Imagery Technological Forecast, by TL Comport, 15 September 1978.

[4]. Defense Communications Agency, DoD Teleconferencing Feasibility Study and Concept of Operation, December 1977.

of the state-of-the-art. By extending and refining this technology to applications which might take five years to develop (normal system cycle time) and anticipating that there are bound to be qualitative changes in the way of doing things and exponential growth in completely unanticipated directions plus the fact that the DoD usually lags the civilian sector in terms of adapting new technologies into their administrative operations by at least five years, the prediction is extended to 1995.

Therefore, for DCA planning purposes, it would appear sufficient to examine present office automation technology projected out about five years. This is not to say that one should not look further ahead than that, if possible. But it is important to scope the study to a reasonably valid forecasting period. Also, given that the foregoing premises are correct, the time frame, of concern for projecting an increased steady-state traffic load on the DCS, due to DoD office automation, is 1990-1995. This is an informed prediction, and requires some explanation. The next ten years will represent a growth period wherein various DoD agencies will gradually automate their information handling functions and resort to DCS networks to transfer information between their offices. The growth in such traffic will increase until the demand stabilizes at some steady state which reflects the extent of planning which can reasonably be implemented within the time involved. This limit, the steady state, then defines a network design goal for a definitive period.

DISCUSSION

Presently, only about 30 percent of an executive's time is available for analysis or creative work. The remaining 70 percent is occupied in face-to-face meetings, telephone calls, looking at reports or traveling. Each of these areas offers good-to-excellent potential for productivity improvement with such automated office applications as electronic mail, teleconferencing and information retrieval designed to support the executive [5].

Most office functions today are carried out very much in the same way they were fifty or a hundred years ago, however, efforts to automate offices are becoming fairly commonplace in the continuing thrust toward reducing labor

[5]. Edwards, M, Automated Office Adds Muscle to White Collar Productivity Drive. Communications News, May 1979, page 70A.

costs. But the concept of linking individuals, organization entities within offices, and remotely separated offices by means of communications networks aided by the computer is an innovative development with enormous consequences for energy conservation and individual worker life-styles. The idea of automated information processing and transfer systems embodies the concept of combining electronic communications media in an integrated systems approach to solving the problems inherent in the paper based information processing and distribution system which exists today. Bringing together voice, facsimile, data processing, word processing, and computers in support of information processing and distribution functions is a major step in the continuing evolution of communications.

The terms "office" and "office worker" are used many times throughout this report and it is important to understand that more is intended by these terms than might normally be expected. "Office" also includes what might be described as a DoD "work center" where any type of information handling and processing takes place. It is intended to imply that a work center and its "office workers" perform more involved tasks than the minor clerical duties of typing, filing, and bookkeeping.

Paper, and paper work, impact on many offices in such volume that there is often little time left to perform creative work after dealing with the paper. The amount of information available far exceeds the motivation to use it or the ability to locate and acquire what is needed or desired even if the motivation exists. There is a dramatic need to increase white-collar productivity and decrease the cost of performing routine business functions. In industry, office workers now comprise 22 percent of the entire U.S. work force and the numbers are growing. The office represents 50 percent of total operating expenses.

The ever increasing cost of labor and virtual explosion of information to be handled coupled with the steadily decreasing costs of computer based technology and communications make automation of office functions a necessity rather than merely a convenience. A great deal of the technology necessary for office automation is available now but hasn't been put into use for a variety of reasons. Many of the technologies have been developed as stand-alone systems and the economic impetus for their integration has not been present. Over the last ten year period capital investment per officer worker

has averaged between $2,500 and $3,000 and productivity has increased a mere 3 percent. During the same period capital investment per factory worker has averaged $25,000 and productivity has increased 85 percent. This is illustrated in Figure A1. It is apparent that for the office worker to become more productive a greater capital investment must be made in office equipment and systems, including changes in office techniques where necessary.

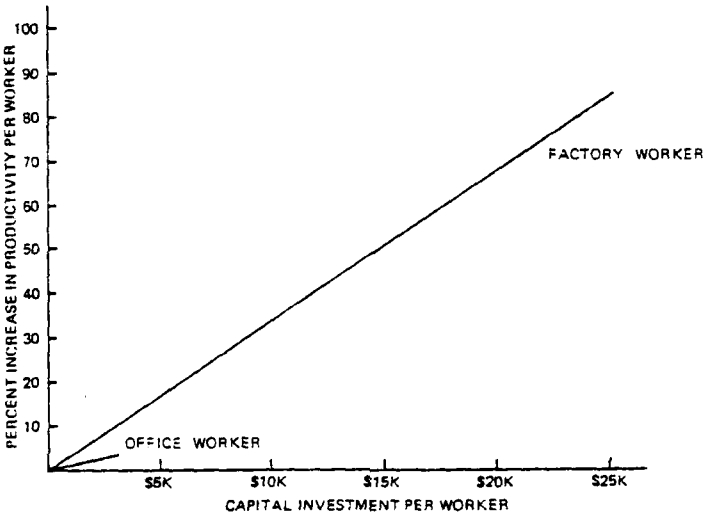


Figure A1. Capital Investment Versus Productivity Over 10 Year Period.

Automation of information processing and distribution in order to increase productivity is not a new idea. The introduction of telephones, typewriters, adding machines and calculators has been in an evolutionary process which has been going on for quite a long time. More recent steps have included the convenience copier, desk-top facsimile machines, programmable calculators and word processors. The next step is based in microelectronics and the wide-spread availability of microwave and satellite communications systems. Microelectronics permits the blending of technologies and the expansion of capabilities for processing information and data while the communications systems provide the medium for real time processing and distribution.

A study of office technology done by Siemens A. G. of Munich, West Germany found that in analyses of the wide range of tasks performed in

offices, one constant factor emerged: Office work serves to inform [6]. Data is constantly produced, shaped, and revised according to rigid and uniform procedures. In terms of functions performed by office equipment, the procedures can be broken down into handling information and processing information. Handling consists of oral exchanges as well as data, text, and graphics. Processing includes data collection, text production, graphics production, documentation and filing or storage. The handling and processing must be tied together with communications. Figure A2 illustrated these concepts.

INFORMATION HANDLING		INFORMATION PROCESSING
ORAL EXCHANGES		DATA COLLECTION
DATA EXCHANGES	COMMUNICATIONS	TEXT PRODUCTION
TEXT EXCHANGES		GRAPHICS PRODUCTION
GRAPHICS EXCHANGES		DOCUMENTATION
		FILING (STORAGE)

Figure A2. Functions of Information Handling and Processing.

According to the Siemens study, before a network of information channels can be automated, office tasks have to be formalized - described in terms of software instructions and algorithms. With knowledge of the time required to complete the task, certain formalized activities can be automated. Everything that can be formalized can't necessarily be automated and in some instances there is a large gap between formalization and automation. Things that can be formalized and automated lend themselves to integration in which one piece of office equipment serves many activities with office activities becoming more closely related than in the past. Figure A3 correlates technologies with the information processing and handling functions which each technology will support. This figure will be more meaningful if it is kept in mind that some pieces of office equipment will be, and are now being, adapted to perform functions previously performed by two or more pieces of equipment and others are being tied together into an integrated system through the use of an electronic switch, a computer, to direct and monitor their activities. The key to such integration is the ability to digitize the output of the equipments tied

[6]. Mokhoff, N, Office Automation: a challenge, IEEE Spectrum, October 1979, page 66.

to the switch so that there is a common language among all of the machines involved. In addition to machine outputs, voice may also be digitized and handled in exactly the same manner. Figure A4 illustrated the digitized interface between machines/ voice and the computer which serves as a switch and controller. Once the digital language is developed to the point where it is computer compatible it can also be communicated to other machines either locally or at a distance over data capable circuits as illustrated by Figure A5.

TECHNOLOGIES \ FUNCTIONS	INFORMATION HANDLING				INFORMATION PROCESSING				
	ORAL EXCHANGES	DATA EXCHANGES	TEXT EXCHANGES	GRAPHICS EXCHANGES	DATA COLLECTION	TEXT PRODUCTION	GRAPHICS PRODUCTION	DOCUMENTATION	FILING (STORAGE)
ELECTRONIC MAIL		●	●	●	●				●
TELECONFERENCING–AUDIO	●				●				
TELECONFERENCING–VIDEO	●			●					
TELECONFERENCING–COMPUTER		●	●	●	●	●	●	●	●
FACSIMILE		●	●	●		●	●		
WORD PROCESSORS		●	●	●		●	●	●	●
INTELLIGENT COPIERS		●	●	●		●	●	●	
ELECTRONIC FUNDS TRANSFER		●						●	
COMPUTER AIDED INSTRUCTION		●	●	●					
COMPUTER OUTPUT MICROFILM		●	●	●				●	●
COMPUTER GRAPHICS				●			●		
PORTABLE COMMUNICATIONS/RADIO PAGING		●	●	●	●				

Figure A3. Correlation of Technologies and Functions

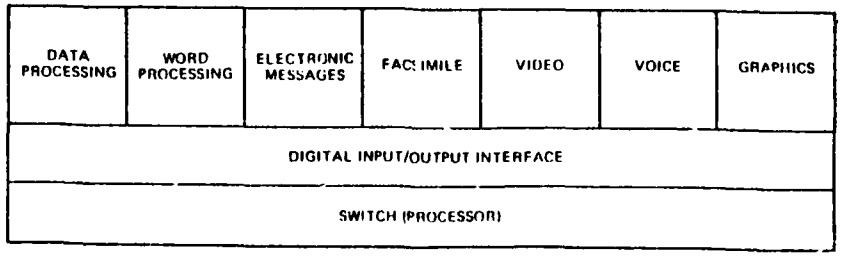


Figure A4. Digital Interconnections Between Office Equipments and a Controller

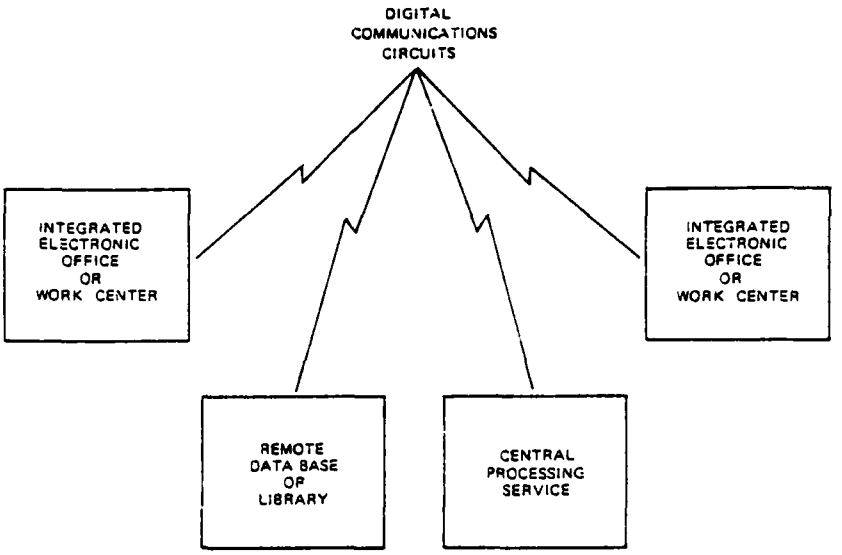


Figure A5. Dispersed or Distributed Office Functions Connected by Digital Communications Circuits

The discussion of computer controllers and switches to manage the interfaces between the technologies in the automated office/work center implies that the computer is located within the office complex. In many cases this will undoubtedly be true but the possibility for imbedding switching and control in the communication network does exist and offers considerable advantage in certain applications.

Mention has been made of the developing technologies and some discussion has been offered pertaining to the reasons for their just now being combined into an integrated system by industry. Development of mini- and microcomputers, digitization of machine outputs/inputs and the availability of adequate supporting communication networks were all cited as contributing to integration. Also to be considered is the fact that the technologies are not at the same point in their life cycle. Some of them are so new as to be still in the developmental phase while others are nearing maturity. In order to make any meaningful predictions about growth of the individual technologies or to project their use in automated offices and work centers of the DoD an understanding of relative life cycle positions is necessary. Such an understanding of the technologies as they now exist in the industrial world may be

acquired through examination of Figure A6. As previously mentioned, the technologies are expected to be assimilated by the DoD about five years after adaptation by the civilian sector, however it is expected that they will maintain their relative positions on the life cycle curve. Also, it must be remembered that technologies are being combined and blended at such a rate as to alter the nominal life cycle. Such innovations as bubble memories, very large scale integration (VLSI) and fiber optics and their incorporation into the technologies will further alter life cycles.

ELECTRONIC MAIL

The report recognizes that there are any number of possible definitions which might be applied to electronic mail and presents two definitions as representative. (1) Electronic mail is the delivery of a document from one place to another by electronic means, and; (2) Electronic mail is a substitute for regular mail in which at least one of the transportation steps is via an electronic delivery.

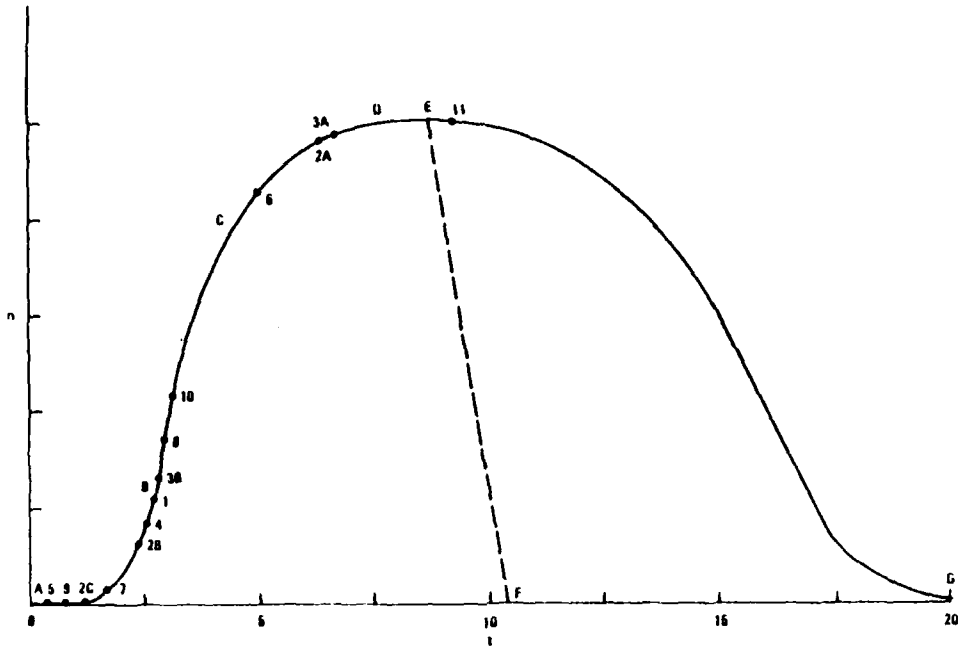
The media for processing electronic mail includes facsimile machines, communicating word processors (including intelligent typewriters, computers and their computer based message systems).

Electronic mail systems may be divided into three general categories: facsimile, word processor, and computer based. The communication networks which support these systems are:

(a) U.S. Postal Service Electronic Mail Service
(b) Common Carrier/Value Added Services and Networks
(c) Corporate/Private/Government Networks

The total electronic mail requirements of any given office may be satisfied by any single combination of a system and a network or any multiple combination of these.

Electronic mail, in one form or another, has already arrived on the scene and is viable and growing. Rising postal costs and decreasing electronic mail costs coupled with the speed of electronic mail delivery assure the continuing growth and success of electronic mail. At least one third of all First Class mail is computer generated and lends itself very well to being processed electronically. Proliferation of communicating word processors, facsimile, intelligent copiers, computer output microfilm, and computer graphics



t - time in years (For industry application)

n - units

Line	Represents
A - B	Initial market entry. Some developmental work still going on. Slight user acceptance.
B - C	General acceptance by users and rapid acceleration of technology applications.
C - D	Market expansion continues, primarily because of decreasing prices due to vendor competition and technical advances.
D - E	Market constant, useage has reached maximum application.
E - F	Market declines because a new technology begins to take over the market.
F - G	Application of the technology continues. Equipment utilized to end of mechanical/electrical usefulness; may be sold by original purchaser in order to make room for a new technology then used by less demanding users.

Estimated positions of examined technologies in their life cycles as of 1980 is indicated by placement of the following numbers on the graph:

1 Electronic Mail
2A Teleconferencing - Audio
2B Teleconferencing - Video
2C Teleconferencing - Computer
3A Facsimile - Analog
3B Facsimile - Digital
4 Communicating Word Processors
5 Intelligent Copiers
6 Electronic Funds Transfer
7 Computer Aided Instruction
8 Computer Output Microfilm
9 Computer Graphics
10 Portable Communications/Radio Paging
11 Electric Typewriters (Shown for comparison purposes only)

Figure A6. Technology Life Cycle

will place greater demands on electronic mail systems and will encourage their development.

TELECONFERENCING

Teleconferencing is a generic term covering a variety of communication modes linking two or more conference participants at a distance. Three principal modes have been identified and studied, audio, video, and computer teleconferencing. Linking of conferees between locations, which may be worldwide, is by means of conventional telecommunications channels and equipment.

These modes may be a hybrid combination of methods. For example, audio conferencing may incorporate facsimile to exchange explanatory graphics, video conferencing almost always involves an accompanying audio link, and in some cases a provision to transmit graphics which are beyond the resolution capabilities of TV cameras. Computer conferencing may have to be augmented by side telephone conversations among participants. In practice, the various conference modes tend to be multimedia in nature.

The intent behind employing teleconferencing between remote locations has been to conduct organizational operations without recourse to frequent face-to-face meetings, to reduce the inconvenience of travel, to cut costs, and to improve productivity.

Teleconferencing, as a mode of communications, has been intensively investigated over the last two decades by common-carriers such as AT&T, Bell of Canada, British Post Office, large companies with dispersed operations such as Dow Chemical, General Electric, decentralized banks such as Bankers Trust of New York, Bank of America, and several Government agencies such as General Services Administration, and NASA. Most of these organizations have implemented either test or operational systems.

The DoD has lagged behind the civilian sector in the application of teleconferencing to facilitate its normal administrative business. However, attempts have been made to apply the concept of teleconferencing to command and control, most notably within the National Military Command Authority structure and within Army, Navy, and Air Force organizational units committed to possible combat roles.

It must be recognized that segments of the DoD differ in their criteria as to the requirements and usefulness of such systems. Time lag, utility, and

availability would outweight cost in command and control situations. Cost versus utility would be a primary issue in the conduct of most DoD adminstrative business.

FACSIMILE

Facsimile is a communications technique that generally falls between the mail system and other methods of page transmission, e.g., teletypewriter. In this position, facsimile has such a broad range of applications that future utilization is almost unlimited. One of the previous limiting factors on the growth of facsimile was the high relative cost per page transmitted as compared to the mail system. Increasing mail costs and delivery delays within the U.S. Postal Service coupled with decreasing costs associated with facsimile have had a positive effect on the movement toward greater utilization of facsimile for transmission of time sensitive material. The telephone company's adoption of a one minute rate, and development of facsimile machines capable of transmitting a page with extremely high resolution in as little as 20 seconds has now made the per page transmission cost by facsimile much more attractive.

The use of facsimile is generally divided into two application categories, convenience and operational [3]. Convenience facsimile provides a service primarily for the convenience of a general class of users and the terminal is operated by the user, rather than by specifically assigned personnel. The equipment may be located on the desk of the user, in his immediate vicinity, or at a central location servicing a larger group of users. Operational facsimile provides a service in support of a specific operational function, such as weather information dissemination, mail distribution, or command and control. The terminal is usually operated by specifically assigned personnel.

Within the Department of Defense, facsimile application does not appear to be as widespread as in the private sector and development seems to trail industry trends. Principal applications are currently centered on the transmission of meteorological maps, data and photographs, and administrative materials.

[3]. NOSC TN524, Facsimile Imagery Technological Forecast, by T.L. Comport, 15 September 1978.

Facsimile machines are being adapted to communicate with devices other than another facsimile machine. The ability now exists to enter information from a keyboard or other type of computer terminal in ASCII or teletypewriter format and have it reproduced on a remote facsimile machine. An ability to transmit documents which have been stored on tape is being developed. These features coupled with polling, "broadcast" or multiple addressing, and automatic retry after receipt of a busy signal tend to lead toward the day when a facsimile system may be hooked up to bulk storage such as a central data base, or "file cabinet" for documents. With such a system, a request for document transmission could be entered from a conventional terminal and the central FAX system would transmit the document to a remote machine at a specified location.

Development of machines which produce copy on plain paper rather than coated paper is expected to decrease paper costs from the present 2 to 10 cents per sheet to about one cent per sheet.

Signal compression has substantially reduced the high bit rate nominally associated with digital transmissions. Economy in transmission time is accomplished by inhibiting the scanner when it is passing over large blank spaces or by rapidly passing over blank spaces. Various algorithms have been developed to further optimize these features. Even further economy, along with higher quality copy, is expected from machines which will preview a document then select an algorithm from its memory which will best handle the type of document to be transmitted (i.e., line drawings, text, photographs, microfilm).

WORD PROCESSORS

Word processors range from relatively simple electronic typewriters with a memory to elaborate terminals incorporating extensive operator aid and storage facilities. Some word processors have communications capabilities built in when they are manufactured and others are capable of being adapted for communications, either in the field or in the manufacturer's service facilities. Most manufacturers now offer some communications facility on their latest machines, either as an option or as a part of the system. Some communicating word processors (CWP) are highly advanced and flexible and can also communicate with compatible mainframe computers, terminals, telexes,

TWXs, photocompositors, and other CWPs. Protocol translators, available either as part of the software in a given CWP or as part of the communicatons network, permit word processors to overcome protocol and code differences when talking with each other and with other devices. Some models of CWPs offer unattended reception with stack paper feeders. A few sophisticated shared-logic systems also offer store-and-forward "electronic mail". A number of display-type WPs offer CRT-to-CRT communications so no paper is required. Others can communicate one document while the operator is working on another (called "background mode" or "background communications"). There is no question that CWPs will be or of the major office links in future information networks [7]. As of the end of 1978 only about a quarter of the 400,000 word processors in the U.S. were communications capable and less than a quarter of those were using the communications mode. These figures might lead to the conclusion that there is some foot-dragging going on as relates to making use of the communications capabilities now existing or available to word processor users. This reluctance to get involved stems from several sources. There has been considerable difficulty about protocol, codes, and standards, - which are now being overcome. Lack of knowledge and understanding of advantages to be gained by going "online" on the part of users has also been a contributing factor. Many of the most successful communications with word processors is now taking place in systems that were originally conceived of as data entry and intelligent terminals networks, supporting the primarily arithmetic-oriented data processing, rather than the word oriented text editing tasks [8]. The development of communications networks, provided by third parties and available as timesharing on-demand, or full-time basis allows WP users to go on-line even if their volume does not warrant acquisition of dedicated full-time circuits to support their communications needs.

Large numbers of word processors are being procured by business and government but few of them are capable of communicating and even fewer are actually used to communicate. Capabilities of word processors are being expanded almost daily as vendors try to include the latest innovation or gimmick in order to meet competition. Some of the fancy frills are not really necessary for most applications but may be played up by the salesman in order to

[7]. Kutnick, D, Communicating Word Processors: A Growing Role in Electronic Mail, Communications News, November 1979, page 50.

[8]. Communicating WP, Datamation, July 1979, page 202.

enhance the prestige of his machine or company. A serious evaluation of needs versus capabilities is indicated during the procurement process.

Communicating word processors are incorporating hardware and software options which closely resemble computer capabilities, including the ability to process data, access remote data bases and libraries, and create graphics. Some may be interfaced to computers, facsimile machines, optical character readers and other peripheral devices designed to extend their capabilities. Several computer vendors and software vendors are offering packages which allow word processing to be performed on mainframe and mini-computers.

INTELLIGENT COPIERS

Intelligent copier, communicating copier, and intelligent copier/printer are terms alternately applied to a new technology in the field of copying and printing. Intelligent copiers are really hybrids that combine a number of technologies, such as those usually found in digital computers, phototypesetters, and the standard variety of xerographic-style copiers. Input to intelligent copiers comes from either computers, communications lines, or word processing systems in electronic form; there is no imaging directly from a document. Simply stated, an intelligent copier is a new type of peripheral device that can be used as an output printer for both word- and data-processing systems, in place of, but more likely in addition to, daisy-wheel printers, matrix printers, or even photocomposition units. In operation, all intelligent copiers receive digitized information, then re-create a line of characters that is scanned by a fiber-optic wafer, a low-powered laser, or some other device. The digitized signal is then transmitted through either fiber-optic wafer, a low-powered laser, or some other device. The digitized signal is then transmitted through either fiber-optic rods, mirrors, or wires, to a photosensitive device that reconstitutes the image dot matrix on a master, drum, or belt. The process is completed with the printing of the required number of pages in the specified number of sets. The most outstanding characteristic of intelligent copiers is their speed of operation. The performance measurement of intelligent copiers is put in terms of pages per minute, as opposed to the

traditional characters per second or lines per minute. The second characteristic of all intelligent copiers is that they have a multiple-font capability [9]. The functional concept of intelligent copiers is shown in Figure A7 [10].

The intelligent copier is a very new technology, just entering the marketplace and still searching for its niche. The intelligent copier processes digital information received either directly from a computer, from a magnetic tape input peripheral, or from a communications line and outputs hard

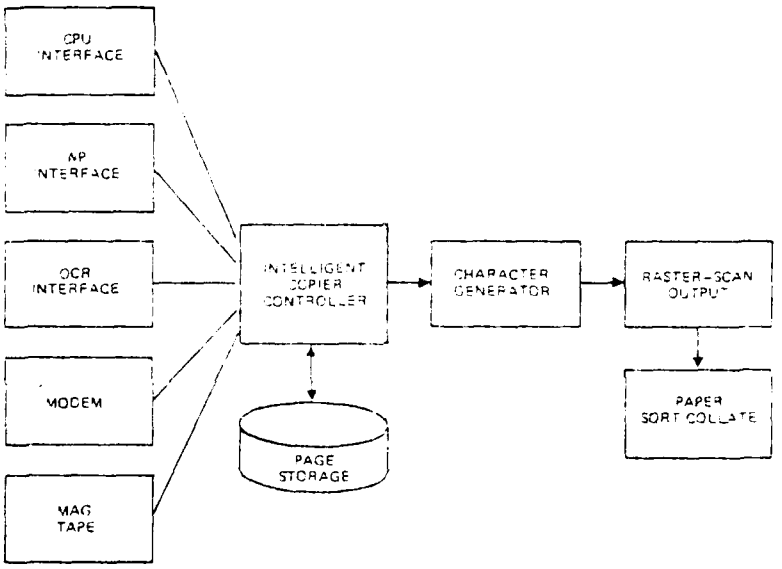


Figure A7. Intelligent Copier Functional Concept

copy at high speeds. Their main application is production of large volumes of printed material which may include text, forms, graphic, or combinations of these.

As a result of high costs involved in purchasing or renting machines, and the large output capabilities which must be fully utilized in order to achieve copy cost effectiveness, these devices are getting off to a slow start. Many

[9]. Nickels, P.J, Repro update: rebirth of a stable technology, Modern Office Procedures, October 1979, page 37.

[10]. Goodstein, L, Output Alternatives, Datamation, February 1980, page 122.

potential users are adopting a wait and see attitude while waiting for prices to come down and for system de-bugging to be completed.

ELECTRONIC FUNDS TRANSFER

Electronic Funds Transfer (EFT) refers to the concept of a checkless, cashless transaction mechanism by which funds are transferred automatically by electronic means. There are several types of EFT systems. Their use is dependent upon the application and environment in which they exist. The thing that all of them have in common is a computer to perform the processing and a communications system to interconnect the various nodes. The types include preauthorized banking services, customer-directed payment systems, point-of-sale systems, credit verification/authorization systems and automated banking facilities.

The greatest acceptance of EFT principles, as well as the greatest application, has been in the area of commercial banking [11].

The Federal Government and certain state and local governments are already committed to the use of EFT in the conduct of their daily business. Social Security payments, welfare payments, government payroll, pension and retirement payments, and government-to-government funds transfers are already handled by EFT systems and have provided many benefits to everyone concerned.

All forms of EFT are expanding in the business environment. Continuing utilization and expansion of preauthorized banking services by government is expected. Requirements for applications of the other four EFT types within DoD is not clearly indicated.

COMPUTER AIDED INSTRUCTION

Computer aided instruction (CAI) refers to any of a wide range of educational techniques that rely on a computer to assist in presentation of learning material. Applications may be as simple as a single student studying with the aid of a desktop personal type minicomputer or may involve many students, a large main frame computer, and an extensive communications network. Curricula may range from basic education through post-graduate studies to specialized technical training and war gaming.

[11]. Computerized Fund Transfer System, Data Communications, February 1980, page 39.

It is not essential for students to be continuously in communication with the computer to obtain the benefit of a computer based system. Indeed, it is possible to conceive of systems where the student is only in intermittent contact with the computer, and these may in fact be economically if not educationally the most profitable systems to develop. It has been shown, however, that on-line "conversation" between the student and computer is an important component of such systems. Computer based systems must not be considered as entirely divorced from the normal human interactions of traditional teaching; they are most likely to complement standard teaching techniques and become integrated with them.

The decreasing costs of computer technology and the increasing complexity and quantity of information to be imparted and assimilated make CAI a very natural tool for helping to solve educational problems. CAI is a growing technology which is just now gaining maturity and which is bound to grow considerably in the next decade.

COMPUTER OUTPUT MICROFILM

The use of computer output microfilm (COM) and computer-assisted retrieval (CAR) in creating, storing, and accessing files and records offers a solution to many of the problems in record management. Virtually anything that can be reduced to paper hard copy form can be stored on microfilm, reducing volume and costs of storage. Use of computers allows microfilmed material to be retrieved from file in a fraction of the time required for paper based systems. Material stored on microfilm may be digitized and processed by computers or transmitted via digital communications circuits.

COM is another of the relatively new technologies which is just achieving maturity. One suspects that it has not gained wider application simply because vendors have not been aggressive enough in their sales efforts. Increasing costs of buildings and storage space for paper based files and the virtual explosion of information which must be stored for both short and long terms assures the continuing growth of this technology.

COMPUTER GRAPHICS

Computer graphics entails the use of a computer to draw a two or three dimensional picture, map, graph, chart, diagram, or rendering for the purpose of illustration or demonstration. The graphic may be displayed on a cathode

ray tube (CRT) or on a plotter which draws directly on paper or overhead projector transparency. Graphics displayed on CRTs may be "dumped" to a plotter or printer which will provide hard copy, or photographed with a high resolution camera to provide a film record.

The use of computer graphics to present information to management in concentrated and highly useful form is one of the most valuable tools to be derived from computer technology. Much of the information now presented to managers is in the form of masses of numbers on computer printout sheets and is literally overwhelming to the busy executive. Since man doesn't think naturally in strings and arrays of numbers, but rather in images, presentation of information in graphic form allows managers to start their thinking processes quicker and to proceed from a base of greater perception [12]. The ability to display computer graphics on a cathode ray tube and to manipulate inputs provides a capability for playing "what-if" games and performing comparative analysis over very short periods of time.

Managers, of course, have always had access to high-quality color graphs and charts drawn by in-house artists. But computers ensure that information is received before it becomes stale. Charts that once took as long as two weeks to develop are now produced in a few hours or minutes, thus enabling managers to see more up-to-date data and to request new presentations on short notice. Middle managers will also be able to play more "what if" games, asking the computer to plot out the results of more than one business scenario [13].

Computer graphics has been around for years, but only recently has it become quick, inexpensive, and friendly via a desktop computer and optional peripherals. Computer graphics may be prepared by a system as small as a "personal" computer with a built-in electrostatic printer or by a large system based in a central computer and having a number of interactive edit terminals, serveral input devices and a selection of output media. Communications capabilities make possible the use of remote databases in preparing computer graphics as well as the delivery of graphics to remote and portable terminals. Development of the microprocessor and decreasing computer and peripheral costs together with a greater understanding of computer graphics capabilities makes

[12]. Kelley, ND, Computer Graphics: Info At A Glance, Infosystems, December 1978, page 37.

[13]. The spurt in computer graphics, Business Week, June 16, 1980, page 104.

it easy to understand the increasing demand for computer graphics in management situations.

Computer graphics in the field of management will probably be the fastest growing of all the technologies considered in this report.

PORTABLE COMMUNICATIONS/RADIO PAGING

Portable communications and radio paging free the executive from the confines of his office while allowing him to remain in contact and control. He may be connected to his office by a radio link or summoned by a radio pager to make contact by telephone or with a portable terminal on a telephone line. Either way, it may be said that his desk travels with him and the facilities of his office are available electronically. The executive can read the mail in his electronic in tray, receive text and graphics messages, address correspondence to others, send notes to himself for later followup, carry on conversations with anyone who has the appropriate terminal and communications facilities on a worldwide basis, or perform a full day's work, all via portable terminals. This technology may be viewed as an invasion of privacy and leisure time by the executive who needs some quiet time away from the office, or as a golden opportunity by the workaholic.

Portable communications and radio paging are growing in the applications and will continue to do so. Executives will increasingly utilize this technology to gain greater mobility. Additionally, portable terminals will be used by those lower echelon personnel who spend their work day away from the office but need access to data bases or libraries in order to carry out their assignments.

CONCLUSIONS

Application of many of the technologies discussed in this report has traditionally been in the area of office services in support of administrative functions. This is especially true for word processors, facsimile, office copiers, computer output microfilm and the various forms of teleconferencing. Computer graphics has generally supported technical and design work while electronic funds transfer and computer aided instruction have each resided in their own niche. Communicating, or intelligent copiers are a new technology, just coming onto the scene and are not fitted firmly into any particular slot. The pervading theme of this report is that computers and computer technology

are paramount to development of information processing and handling systems of the future. The concepts involved in bringing about an integrated electronic office through digitizing the input and output of information processing and distribution equipments and then using a controller, a computer, to tie everything together and direct the interface is discussed and illustrated. It soon becomes obvious that if such concepts are to evolve in an orderly fashion and achieve the ultimate goal, an electronic integrated office system which is cost effective and highly productive, then there must be an improved understanding on the part of users of the concepts involved. Likewise, the disciplines currently applied to data processing must be applied to the computer controlled office equipments. The ideal situation would be for the devices to be transparent to the operator but for this to be so there must be an involvement of computer personnel, programmers, systems analyst, and data base managers. Presently, the more sophisticated word processors come with their own software packages, and some hardware features, which are better understood by computer programmers and operators than they are by the usual word processor. The initial incorporation of an electronic mail system into an existing main frame computer requires an understanding of office workflow which is not generally possessed by the computer programmer or perhaps even by a systems analyst who is prone to think in terms of data processing applications. The same may be said of the data base manager who is faced with accommodating word processing in what heretofore has been a data oriented world. When the requirement for communications between various nodes of the office system (remote libraries, microfiche files, dispersed processing terminals, etc.) are added to the picture then there must also be an understanding between the administrative office manager, the data base manager, and the telecommunications manager. Vendors are already producing terminals which are designed to interface with several of the technologies discussed, with the full expectation that this is the way of the future.

The development of the integrated electronic office will occur in an evolutionary process as a need is perceived to apply the technologies and as funds are made available for procurement of necessary hardware, software, communications networks, and specially trained personnel. The movement towards automation of information processing and handling systems will be dictated by the necessity to reduce travel, cut information transfer costs associated with

traditional processing and delivery methods, and to reduce transfer delays of important and perishable information.

The move towards office automation has already started in both industry and government. It will accelerate as the costs associated with personnel continue to increase while those associated with hardware and communications continue to decrease.

Personnel, both the manager-user's of the integrated electronic office and the system operators will be a major factor in the speed with which the new technologies are acquired and the success of the systems after they are in place.

(a) Management personnel. Management oriented personnel who enter the field of office administration and the chain leading to top management positions in the field of administration usually have certain basic skills which they have acquired in costs of operating administrative functions but their employment in this area will require that their costs be at least prorated among all departments who use their services.

The research conducted has led to the conclusion that there are, for the most part, no industry wide standards for protocols to be applied within the interfaces between equipments. It is understandable that such diverse technologies as word processing and facsimile, each of which developed as standalone technologies, have given little or no thought to the interfacing of those technologies which is now taking place. However, even within a single technology the same interface problems exist. Front-end or in-line processors have been developed to overcome some of the problems but not all. Some pretty strange things still happen when a word processor which uses one algorithm to perform word underlining is interfaced to a machine which uses a vastly different algorithm. Continuing development of microprocessors and their incorporation into equipment communications interfaces to overcome these incompatibility problems is bound to help, but greater attention is needed in this area. If universal communications compatibility is not achieved between every model of each of the represented technologies, then consideration must be given at time of systems procurement to acquiring systems and equipments which are compatible. Close coordination between those individuals who acquire systems and experts in the field of telecommunications is strongly indicated.

APPENDIX B: SUMMARY OF MAR, INCORPORATED TECHNICAL REPORT NO. 257, IDENTIFICATION OF TELECOMMUNICATIONS DEMANDS BY DOD SERVICES WITH REGARD TO NONTACTICAL COMMUNICATIONS NEEDS, DECEMBER 1980

INTRODUCTION: A survey was conducted to obtain information to be used for projecting the telecommunications requirements and patterns resulting from implementation of office automation technology. Selected representatives from seven Department of Defense (DoD) Military Departments (MILDEPS) and Agencies were interviewed to obtain current and projected activities that are or will employ office automation technology. Emphasis was placed upon projections of future developments in office automation that have a high probability of affecting communication demands upon the DCS network. The seven MILDEPS and Agencies queried were Defense Logistic Agency (DLA), Defense Intelligence Agency (DIA), Defense Communications Agency (DCA), Departments of the Army (USA), Navy (USN), Air Force (USAF) and Marine Corps (USMC).

SUMMARY OF INTERVIEWS WITH MILITARY DEPARTMENT AND AGENCY REPRESENTATIVES

DLA - Plans for procurement of Nationwide communicating word processor network

DIA - A ten year Master Plan which includes:

- A facsimile net, using AUTODIN II for daily traffic volumes estimated to reach 3000 messages per day.
- World-wide data base query. Anticipates use to increase with experience.
- Communicating Word Processors. Current plans are for accessing local data bases with expansion as transmission circuitry efficiency is increased.

DCA - Document development and coordination regarding use of computer conferencing techniques were prepared. Computer conferencing networks were established and discontinued.

A summary of the type problems encountered are: Obtaining terminals and action officer familiarity with operation of the terminal in the network; social factors: individuals interact differently in a computer conference than they do in a face to face conference.

Most of these problems are expected to diminish significantly as office automation becomes more prevalent, and as individual action officers and conference leaders become more experienced in computer conferencing.

Computer conferencing is seen as being more attractive to technical personnel because technical personnel are usually more accustomed to non-personal forms of communication. Computer conferencing is also seen as being particularly useful in crisis operations where timeliness in obtaining essential information is more important than receiving smoothed polished statements.

- Communicating Word Processors, are being implemented to facilitate internal processing and staffing of correspondence.

USA - Electronic Mail and text editing is currently employed by some 1300 DARCOM users. Plans include testing electronic mail using two PDP-1170 systems equipped with a variety of terminals, printers and autodialers.

The next development in DARCOM will be to establish office clusters consisting of a microprocessor, eight dumb terminals and one printer. Additional software packages will be developed. The estimated cost of each of these clusters is forty-seven thousand dollars. DARCOM currently projects that twenty to thirty thousand personnel in DARCOM will be serviced by these clusters by 1985. The overall architecture plan for interconnecting the clusters is to tie the microprocessors on a local bus network with a controlled cue query for shared data bases. Transmission of classified data will require installations adhering to the Red/Black standards. Pilot studies of electronic mail systems are being conducted at Fort Benning, Fort McPherson and Fort Ord.

Automatic retrieval and transmission of records. A major telecommunications impact is expected over the next five years resulting from current efforts to accomplish a computer aided microfiche storage and retrieval system.

The Army is in the early stages of accomplishing a HQDA staff computer network for improved and more efficient use of the Force Structure Data Base. USAMSSA will continue to maintain the central

data base. A network control center will be installed to control 13 remote processing centers which consist of mini computers located in the Washington, D. C. area at command and staff levels in the Pentagon, at MILPERCEN, Hoffman Building, the Army Concepts Analysis Agency in Bethesda, and the Army Research Development and Acquisition Information System Agency at Radford, Virginia.

Upon successful implementation and operation of the HQDA network, plans are to expand the system to include major Army installations in CONUS. The purpose is to provide interconnection between major Army Commands with high speed data links interconnecting a centralized data base. Specific estimate of data rates or of traffic volume is not available at present. The potential exists for expansion overseas but that effort is even less defined than the CONUS expansion.

USN - Navy Information Management System (DONIMS) is an electronic mail system for Navy offices in the Washington area that uses optical character readers (OCRs), keyword/phrase indexing for correspondence routing and control.

- Navy Surface Weapons Center Experiments. A pilot system to provide electronic mail, word processing, teleconferencing, data distribution, data base management, information cataloging and data processing interconnected by a 9600 baud external transmission net between four processing nodes, using 66 terminals.

- Ships Parts Control Center, Mechanicsburg, PA, is participating in a pilot program for office automation system productivity measurement.

- Technical Office Automation and Communications System (TOFACS) - addresses advantages of electronic mail and conferencing techniques. The David Taylor Naval Ship Research and Development Center is incrementally implementing office automation on an experimental basis. At present there are fourteen video terminals active. These terminals are interconnected by a PDP-1170 minicomputer equipped with word processing software. This system is used for electronic mail, text processing, maintenance of calendars, scheduling meetings, and providing assistance to the engineer/

scientist in the form of plot generation, developing graphic displays and computational support.

Additional terminals are being purchased to expand the system. Continued success in office automation is expected to result in office automation throughout the center. A goal is to establish electronic mail and conferencing with elements of the Naval Ship Research and Development Center located at Annapolis, Maryland in order to decrease travel requirements. One method under current consideration is the use of electronic blackboards. Closed circuit television is desirable but not currently considered feasible.

- Other Navy systems, descriptions and status of Navy systems are presented for

  - Shipboard Nontactical Automated Data Processing (SNAP) and (SNAP II). Primary applications are envisioned as processing of supply, finance, personnel, maintenance and administrative actions aboard ship.

  - Navy Technical Information Presentation (NTIPS). A goal of NTIPS is to convert technical information into digital form for storage and transmission to user sites.

  - Navy Automated Publishing System. The Navy Publications and Printing Service Management Office is pursuing a long range plan to evolve from centralized printing to servide center printing with the eventual goal of accomplishing printing at user sites. The estimated annual volume of printing accomplished by the Navy Printing and Publishing Service is 10 billion pages per year. The Navy currently maintains a document warehouse encompassing 5 city blocks in which materials are stocked for replenishment (secondary) distribution. A typical Navy carrier ship stocks about 15 tons of pre-printing documentation.

    It is considered likely that by sometime in the mid 1990s all publications will be electronically distributed direct to the users, stored at user site in digital form (magnetic

tape, disk or some other non volatile form). Users will access material by computer assistance, and printing will be accomplished on demand basis. The use of military communication circuits for transmission of the digitized electronic input to the intellegent copiers/electronic printing systems is considered to be a very attractive alternate to use of the mail and other conventional distribution methods.

USAF - Publication Information, Printing and Processing (PIPPS) is an experimental system using word processors and electronic mail to automate document update and production.

- Air Force Data Services Center is experimenting with office automation with a goal of reduced manpower and changes to work patterns and organizational structures.
- Improved Administrative Capabilities Test (IMPACT). An experimental configuration is installed at Hanscom Field in support of the Air Force Systems Program Offices (SPO).
- Command Management Information System (CMIS). The CMIS is being developed to provide an Air Force Systems Command information system. The CMIS will link all major departments, laboratories and test centers with an integrated data base information system.
- Other Air Force activity in office automation. Command wide information systems are being developed by the Strategic Air Command and the Air Force Logistics Command. On base information management systems are being developed at Bolling AFB and Air Force installations in San Antonio, Texas.

USMC - Plans includes utilizing DOMIMS to support Hq USMC. No development efforts are planned other than monitoring industry off-the-shelf equipments.

USCG - The U.S. Coast Guard has created a special two year study group to address implementation of automation information management and to determine the potential benefits and impacts of automated information technology. To this end, the study group is composed of Coast Guard personnel proficient in electrical engineering,

data processing, word processing, telecommunications, research and development, and administrative management. The study group has been in existence for six months. Planning strategy which is emerging at present includes addressal of organizational structure within the Coast Guard Headquarters which will facilitate addressal of the interactions between telecommunications, automated information systems and field operations. Preferred policy at this time is one which will provide maximum encouragement for local level innovational development of automation. Directives from Headquarters Coast Guard are foreseen to be broad policy statements which include guidance in areas to be consicered during implementation of automation. Coast Guard Automation efforts to date are outlined below,

- Centralized Data Bases.
  - Financial Information System. The Financial Information System is operated under the purview of the Coast Guard comptroller. Information from field units is transmitted to Headquarters Coast Guard for inclusion into the data base.
  - Merchant Ship Information System. A centralized data base is maintained which provides information concerning merchant ship locations and planned routes.
  - Marine Safety. A centralized data base is maintained which allows direct access by Coast Guard districts. A contract with GTE Telenet has recently been accomplished for adding a "Value Added Network" to this system. The Coast Guard will operate a computer center from New York. Interconnected terminals will interchange information for control of helicopters and boats, and for execution of search pattern algorithms.
  - Personnel Management Information System (PMIS). The Personnel Management Information System is a 15 year old batch processing system. Field units at Corpus Christi, Molby, and 8th District Headquarters are using IBM System 6 word processing systems for preparing input to the PMIS (as well as performing other local functions).

- Joint Uniform Military Pay System (JUMPS). The Coast Guard is considering adoption of the JUMPS system. At present there is preference in the Coast Guard for a distributed processing system rather than a centralized JUMPS system.

- Management Analysis Group at Coast Guard Headquarters. The Management Analysis Group has a standalone system, known as CPT, which is used for developing publications, index lists and distribution lists. A standalone Lexicon word processing system is used for general typing.

- Implementation Activity
  - District Minicomputer System. The Decision Support System Study Group is developing an architecture for a district minicomputer system which will support approximately 30 field managers. The system will provide support on a demand basis allowing users to obtain information from the centeralized data bases. Provision will be included for local data manipulation of information received from central data bases, or information obtained locally.
  - The IBM System 6 Word Processing System. Installations at Corpus Christi, Molby and 8th District Headquarters have word processors installed which are used for maintaining personnel records and validating travel orders in addition to providing input to the Personnel Management Information System. The Corpus Christi System is also being used by operations, engineering and finance personnel.
  - Local Implementation. Field commands are evolving the use of word processors for use in research and development, administration and finance. Equipment is being obtained under local funding authority.
  - Semi-Automated Message Processing System (SAMPS). The Coast Guard Office of Telecommunications Management is implementing a system to reduce the manpower intensiveness of District Communications Centers. The system is expected to provide sufficient increases in efficiencies to allow the communication centers to meet anticipated annual increases in message traffic within existing levels of

personnel resources. The SAMPS is envisioned as the significant initial step toward the development of an integrated Coast Guard Telecommunications Network, capable of processing record message, data and electronic mail.

The Concept of SAMPS began when the 17th Coast Guard District acquired an HP-9825 calculator to prepare teletype tape text of long fisheries messages as part of their ALPAT Management Information System. The same calculator was also used to convert MILSTRIP cards to tape for entry into AUTODIN. The 5th Coast Guard Division has implemented a program which integrates the division word processing system into the SAMPS Communications Center Program. Messages are entered at work stations within the district and transferred electronically to the Communications Center for transmission on the District's teletype circuits.

SAMPS will be used to replace teletypewriter equipment on unclassified circuits, and be expanded to integrate word processing, data processing, and telecommunications. A long range goal is to develop the capability for the SAMPS system to accomplish automatic periodic polling of each of the 12 Coast Guard District's data bases.

SUMMARY OF INTERVIEW STUDY

Considerable interest in office automation exists within the Department of Defense and the MILDEPS and Agencies. Individuals interviewed during this survey report that initiation of pilot programs result in strong enthusiasm from the participants and strong expressions of desire from other organizational elements to be included. The primary impetus for this interest and enthusiasm is the recognized need for improved individual and organizational productivity. Most organizations are experiencing periodical incremental decreases in the number of authorized positions. At the same time, these organizations are receiving pressure to accomplish the same or additional work loads in less time. The volume of information to be gathered and coordinated is increasing as military systems become more complex and additional attention is being placed on interoperability, commonality and integration of military actions.

This survey shows that office automation is being actively pursued by members of the Department of Defense. For the purpose of establishing a general overview of the nature of these actions, it appears convenient to view them in two broad categories. One category being actions to automate a specific function in an integrated fashion which crosses organizational boundaries. The other category being actions to provide office automation within local organizational elements.

Examples of this category are found in the Air Force Publication Information, Printing and Processing System (PIPPS) and the Navy Automated Publishing System. These programs have the potential for servicewide application of automation in an integrated fashion for the accomplishment of document preparation, coordination, distribution, storage and revision of updates. The eventual system is conceived as one in which the writer, coordinator and user are interconnected by automated technologies.

The Department of the Navy Information Management System (DONIMS) is another system which can be described as a functional automation system which crosses organizational boundaries. Current goals for the program envision that DONIMS will essentially be limited to the Washington, D.C. area. The possibility for extension of DONIMS or a compatible system to field locations does exist, and part of the system philosophy being followed by the DONIMS project office includes remaining awareness of maintaining the capability for accomplishing expansion to field and lower levels.

Systems of this nature have project offices at or near the Military Department head and there are at least some general ideas of directions the system will take in future years. Innovationas and new developments in technology will affect the specific manner in which the systems are implemented, but major breakthroughs in technology would be required to significantly change the system concept. The means of transmission of this information has not been resolved. It appears that information may be transferred in magnetic form by mail or courier or transferred over military circuits. This decision concerning transmission of information is a policy type decision which several individuals reported as being potentially controversial.

Projects are aimed at experimenting with office automation concepts employed at organizational elements are DARCOM Expanded Prototype Cluster, the Navy Ships Parts Control Center Project, the Technical Office Automation and

Communications System Project at David Taylor Naval Ship Research and Development Center, and Navy Surface Weapons Center Experiment. The purpose of current efforts are to select concepts which will facilitate the accomplishment of automation of a center or a command. The structure of these efforts at present appears to be one which will lead toward a single integrated facility which incorporates automation of all functions.

Activities in this category are characterized by an iterative process of selecting automation applications, experimenting with them, developing new insights and new concepts for additional experimentation.

This dynamic evolution of concepts and methods of employment of office automation provides very little visibility of future applications. It does show that the area is active. Individuals report high interest and enthusiasm. Work patterns of individuals are significantly changed by office automation. Individuals report that implementation of office automation offers the potential for increased span of control. Postulations are that implementations of office automation could make it possible to streamline management of an organization and allow departure from traditional ways of organizing a work force. Projections for future traffic volume are difficult to obtain. Some individuals report that there will be little or no change in volume of traffic leaving or entering an organization. Their rationalization is that information will be transferred as required. Office automation will make it easier and more efficient to transfer information, but since people are generally reluctant to perform unnecessary effort, they will refrain from going to the bother of transferring information unnecessarily. Some individuals point out that about one in every four attempted telephone calls are actually completed. Their point is that the use of electronic mail offers a higher completion rate (the "called" center is never away from its desk, so to speak), and transmits information at a higher rate than spoken voice.

Organization automation is often initiated at the local level. Current dollar thresholds for procurement of equipment are low enough that organizations can implement office automation without coming to the attention of Military Department needs.

Often office automation projects can be started by taking advantage of available capabilities of equipment justified for other purposes but not fully used for that purpose.

The distinction between these categories appears useful in describng different approaches being taken toward office automation. There does not appear to be a generic distinction between these categories. It appears quite likely that they will merge as office automation capabilities become more prevalent.

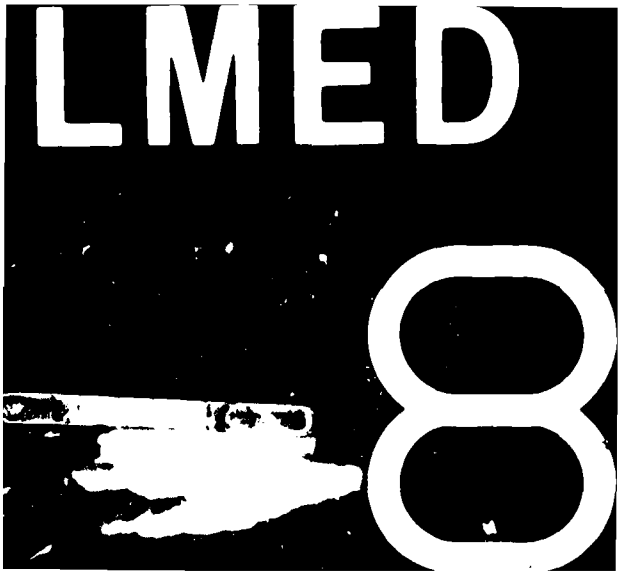
Interviews conducted with personnel outside the Department of Defense included the U.S. Coast Guard. Results of these interviews reveal the establishment of a study group composed of experts from multiple disciplines. The aim of the Coast Guard study group is to determine the potential benefits and impacts of automated information technology. The study group is addressing centralized data bases and systems that are in various stages of implementation. The centralized data bases include financial, personnel, merchant ships, marine safety, and military pay. The systems being implemented include word processors and semi-automated message processing.

SIGNIFICANT FINDINGS AND CONCLUSIONS. Uncertainties concerning available technology from industry, methods of implementing office automation, future directives from the Federal Government and concern for potential conflicts in jurisdiction have inhibited development of definitive policy or long range plans. Most individuals report that industry products are developing rapidly enough that optimum choices of equipment are likely to be obsolete within six months; these individuals also report that as soon as a system is installed there quickly appears insight on how to improve the application. A need is recognized by many for resolving viewpoints taken by requirements personnel, administration personnel, automatic data processing personnel and telecommunications personnel. One individual stated that he has felt for several years that an Information Management Agency should be formed at the Department of Defense level which was staffed with representatives from at least administration, ADPE hardware procurement and telecommunications. The responsibility of this agency would be to issue broad guidance and to oversee the architecture of office automation programs in order to ensure that an effective flow of information can be accomplished.

Long range plans are difficult to develop because it is felt that each office automation project should be tailored to each specific application. As of yet, no one believes that a universal office automation package has been developed which is suitable for all applications.

Quantitative figures for telecommunication requirements between organizations and posts, bases and centers are not available at this time. The office automation projects are devoting most of their attention to forming concepts for intra-office configurations with secondary attention to intraorganization integration. The Air Force CMIS project offices is considering use of satellite links for interconnection of Air Force Bases. Impressions received during interviews are that methods for interconnection of organizations, posts and bases are in the very early conceptual stages. Definitization of specific traffic types and volumes can not be accomplished until office automation is implemented and experience is observed in order to determine how the users of office automation will develop their traffic patterns. Repeatedly, personnel being interviewed stated that introduction of office automation changes individual and organization work patterns. No one interviewed expressed the opinion that they were beginning to see a stabilization or leveling off of inovation.

Implementation of office automation will place a significantly larger portion of information in electronic digital form. With expected technology developments, it is conceivable that within two or three years, all information may be readily placed in digital electronic form. Individuals who have a communicating word processor or similar terminal that is compatible with his or her counterparts' device will tend to use electronic transfer of information by this means rather than by use of military message, facsimile, mail, voice telephone, or a trip. In short, individuals will tend to employ the transfer means that is easiest and quickest to use. The volume of interorganizational traffic via office automation will be heavily impacted by local administrative policy decisions concerning release authority and access to interorganization trunk lines. Individuals familiar with introduction of new methods report that there is usually a spurt of activity with new capabilities that reverts back to normal levels within two or three months.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